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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicant: Joseph Phillip Bigus, Brian John Cragun,  
Helen Roxlo Delp

Atty. Docket: IBM / 02B  
Client Ref.: RO996-054L

Title: INTELLIGENT AGENT WITH NEGOTIATION CAPABILITY AND METHOD OF  
NEGOTIATION THEREWITH

**CERTIFICATE OF MAILING BY EXPRESS MAIL - 37 CFR 1.10**

'Express Mail' mailing label number: EL328380474US

Date of Deposit: November 2, 1999

I certify that this paper or fee (along with the enclosures noted herein) is being deposited with the United States Postal Service 'Express Mail Post Office to Addressee' service under 37 CFR 1.10 on the above date and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

By: Heath R. Bandy (person mailing paper)

**UTILITY PATENT APPLICATION TRANSMITTAL**

***BOX PATENT APPLICATION***

*Assistant Commissioner for Patents  
Washington, D.C. 20231*

This is a request for filing, under 37 CFR § 1.53(b), a(n):

- ☐ Original (non-provisional) application.
- ☒ **Divisional of prior application Serial No. 08/821,935, filed on March 21, 1997.**
- ☐ Continuation of prior application Serial No. \_\_, filed on \_\_.
- ☐ Continuation-in-part of prior application Serial No. \_\_, filed on \_\_.

For Divisional and Continuation applications ONLY:

- ☒ **Copy of Executed Declaration, Power of Attorney and Petition Form from parent application is enclosed (as noted below in Enclosures).**
- ☒ **Incorporation by Reference: The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied herewith, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.**

For all Divisional, Continuation and Continuation-in-part applications:

- ☐ A Small Entity Statement was filed in the prior application, small entity status is still proper and desired.
- ☒ **This application is assigned to INTERNATIONAL BUSINESS MACHINES CORPORATION by virtue of an earlier assignment filed in the prior application at Reel 8525, Frame 0176-0177.**

**PRELIMINARY AMENDMENT/CALCULATION OF FEES**

- ☐ Please cancel claims \_\_ without prejudice, and prior to calculating the fees. \_\_ total claim(s), of which \_\_ is(are) independent, is(are) pending after the amendment.
- ☒ Please enter the enclosed preliminary amendment identified below prior to calculating the fees. 19 total claim(s), of which 3 is(are) independent, is(are) pending after the amendment.
- ☒ The Fees are Calculated as Follows:

Fee:	Number of Claims:	In Excess of:	Extra:	At Rate:	Amount:
Total Claims	19	20	0	\$18	\$0.00
Independent Claims	3	3	0	\$78	\$0.00
MULTIPLE DEPENDENT CLAIM FEE					
BASIC FEE					\$760.00
TOTAL OF ABOVE CALCULATIONS					\$760.00
REDUCTION BY 50% FOR FILING BY SMALL ENTITY					
TOTAL					\$760.00

**ENCLOSURES**

- ☒ Utility Patent Application Transmittal Form (in duplicate) containing Certificate of Mailing By Express Mail Under 37 CFR 1.10.
- ☒ Return Postcard.

APPLICATION PAPERS

- ☒ Utility Patent Application, with: cover sheet, 88 page(s) specification (including 103 total claim(s), of which 15 is(are) independent), and 1 page(s) abstract.
- ☒ Drawings: 11 sheet(s) of formal drawings (14 total figure(s)).
- ☐ Microfiche Computer Program (Appendix).
- ☐ Nucleotide and/or Amino Acid Sequence, including (all are necessary): Computer Readable Copy, Paper Copy (identical to computer copy), and Statement verifying identity of copies.
- ☐ An \_\_ Declaration, Power of Attorney and Petition Form.
- ☒ Copy of Executed Declaration, Power of Attorney and Petition Form from prior application identified above.
- ☐ Certified Copy of priority document(s) identified as attached above.

ADDITIONAL PAPERS

- ☐ Assignment to \_\_, Recordation Cover Sheet (Form PTO-1595)
- ☐ Verified Statement to Establish Small Entity Status under 37 CFR 1.9 and 1.27.
- ☒ **Preliminary Amendment (to be entered prior to calculation of fees)**
- ☒ **Information Disclosure Statement, 13 sheet(s) Form PTO-1449**
- ☒ **Other: Copy of Substitute Power of Attorney and Certificate Under 37 CFR 3.73(B) with copy of Assignment attached**

CHECKS

- ☒ **A Check of \$760.00 for the filing fee.**
- ☐ A Check of \_\_ for the assignment recording fee.

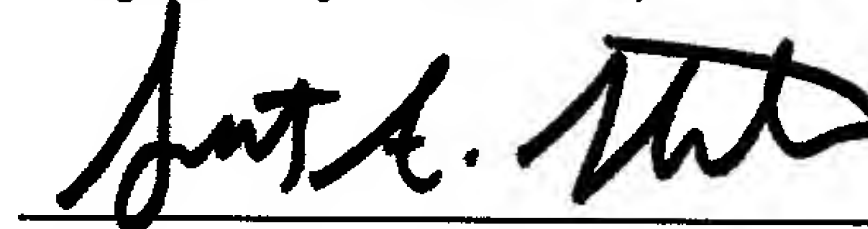
**DEPOSIT ACCOUNT AUTHORIZATION**

- ☐ Please charge Deposit Account No. 23-3000 in the amount of \_\_.
- ☒ **The Commissioner is authorized to charge any fees under 37 CFR 1.16 and 1.17 which may be required during the entire pendency of the application, or credit any overpayment, to Deposit Account No. 23-3000. A duplicate of this transmittal is attached.**
- ☐ **THE PAYMENT OF FEES IS BEING DEFERRED.**

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SAS/jlv

Respectfully Submitted,



Scott A. Stinebruner  
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Express Mail No. EL328380474US

PATENT

IBM/02B

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicant: Joseph Phillip Bigus et al.	Art Unit: Unknown
Serial No.: FILED HEREWITH	Examiner: Unknown
Filed: October 18, 1999	Atty. Docket No.: IBM/02B
For: INTELLIGENT AGENT WITH NEGOTIATION CAPABILITY AND METHOD OF NEGOTIATION THEREWITH	

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**PRELIMINARY AMENDMENT**

Assistant Commissioner for Patents  
Washington, DC 20231

Sir:

Please amend the above-identified patent application as follows:

**Amendments**

**In the Specification**

Please delete the paragraph at page 1, lines 5-18, and substitute therefor the following paragraph:

--This application is a divisional application of U.S. Serial No. 08/821,935, filed on March 21, 1997 by Bigus et al., entitled "INTELLIGENT AGENT WITH NEGOTIATION CAPABILITY AND METHOD OF NEGOTIATION THEREWITH." This application is also related to the following U.S. Patent Applications, all of which were filed by Bigus et al.: U.S. Serial No. 08/822,119 filed on March 21, 1997 and entitled "APPARATUS AND METHOD FOR COMMUNICATING BETWEEN AN INTELLIGENT AGENT AND CLIENT COMPUTER PROCESS USING DISGUISED MESSAGES," U.S. Serial No. 08/826,107 filed on March 21, 1997 and entitled "APPARATUS AND METHOD FOR OPTIMIZING THE PERFORMANCE OF COMPUTER



TASKS USING MULTIPLE INTELLIGENT AGENTS HAVING VARIED DEGREES OF DOMAIN KNOWLEDGE,” and U.S. Serial No. 09/100,595, filed on June 19, 1998 and entitled “OPTIMIZING THE PERFORMANCE OF COMPUTER TASKS USING INTELLIGENT AGENT WITH MULTIPLE PROGRAM MODULES HAVING VARIED DEGREES OF DOMAIN KNOWLEDGE” (which is a divisional of U.S. Serial No. 08/822,993 filed on March 21, 1997 and entitled “APPARATUS AND METHOD FOR OPTIMIZING THE PERFORMANCE OF COMPUTER TASKS USING INTELLIGENT AGENT WITH MULTIPLE PROGRAM MODULES HAVING VARIED DEGREES OF DOMAIN KNOWLEDGE” (now abandoned)). The disclosures of all of these applications are hereby incorporated by reference herein.--

At page 17, line 28, please delete “Serial No. \_\_\_\_\_” and substitute therefor --Serial No. 08/822,119--.

At page 18, line 8, please delete “Serial Nos. \_\_\_\_\_ and \_\_\_\_\_” and substitute therefor --Serial Nos. 08/826,107 and 08/822,993--.

In the Claims

Please cancel claims 1-53 and 64-103 without prejudice.

Please add the following new claims 104-112:

--104. (New Claim) The apparatus of claim 54, wherein each of the plurality of attributes has a weighting factor associated therewith.

105. (New Claim) The apparatus of claim 104, wherein the identification module is configured to calculate an accumulated weighting factor for each known party by summing the

weighting factors of the attributes of the known party which match those of the unknown party, and to identify the unknown party as the known party with the largest accumulated weighting factor.

106. (New Claim) The apparatus of claim 54, wherein the unknown party is an intelligent agent configured to conduct electronic transactions, and wherein the plurality of attributes are selected from the group consisting of an agent name, a client name, a bank name, a bank account number, a credit card number, a homebase location, an agent program name, a location or name of a source with which the unknown party communicates, and combinations thereof.

107. (New Claim) The apparatus of claim 54, wherein the unknown party is an intelligent agent, and wherein the identification module is configured to scan program code for the unknown party to determine attributes thereof.

108. (New Claim) The program product of claim 61, wherein the program is configured to determine a plurality of attributes related to the unknown party, and to compare the plurality of attributes for the unknown party with those of the plurality of known parties.

109. (New Claim) The program product of claim 108, wherein the program is configured to access a database including a plurality of records, each record associated with a known party and including the plurality of attributes related thereto.

110. (New Claim) The program product of claim 108, wherein each of the plurality of attributes has a weighting factor associated therewith, wherein the program is configured to calculate an accumulated weighting factor for each known party by summing the weighting factors of the attributes of the known party which match those of the unknown party, and to identify the unknown party as the known party with the largest accumulated weighting factor.

111. (New Claim) The program product of claim 108, wherein the unknown party is an intelligent agent configured to conduct electronic transactions, and wherein the plurality of attributes are selected from the group consisting of an agent name, a client name, a bank name, a bank account number, a credit card number, a homebase location, an agent program name, a location or name of a source with which the unknown party communicates, and combinations thereof.

112. (New Claim) The program product of claim 108, wherein the unknown party is an intelligent agent, and wherein the program is configured to scan program code for the unknown party to determine attributes thereof.--

#### Remarks

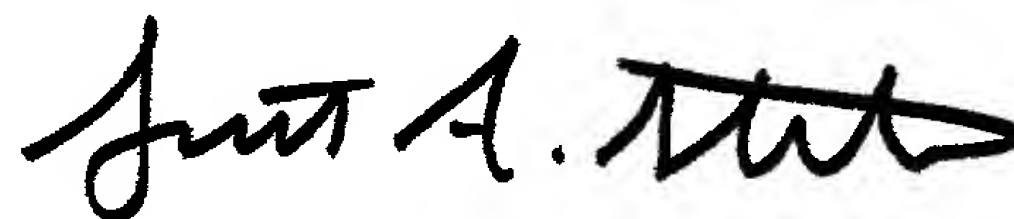
The above amendments are being made prior to the calculation of filing fees for the above-identified patent application. Applicants hereby reserve the right to refile the cancelled claims in this or a future copending application. Moreover, the amendments are not directed to new matter, nor are they being made in response to any art-based rejection. Consideration and allowance of all pending claims are respectfully requested.

If there are any questions regarding this paper, or which might otherwise further this case onto allowance, please contact the undersigned at (513) 241-2324. Moreover, if any other charges or credits are necessary to complete this communication, please apply them to Deposit Account 23-3000.

Respectfully submitted,

2 NOV 1999

Date



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Express Mail No. EL328380474US

IBM DOCKET: RO996-054L

WHE DOCKET: IBM-02B

**APPLICATION**  
**FOR**  
**UNITED STATES LETTERS PATENT**

**TITLE:** **INTELLIGENT AGENT WITH NEGOTIATION CAPABILITY  
AND METHOD OF NEGOTIATION THEREWITH**

**APPLICANTS:** **Joseph Phillip Bigus, Brian John Cragun, and Helen Roxlo Delp**

**ASSIGNEE:** **International Business Machines Corporation**

**Wood, Herron & Evans, L.L.P.**  
**2700 Carew Tower**  
**Cincinnati, Ohio 45202**  
**513-241-2324**

**SPECIFICATION**

**INTELLIGENT AGENT WITH NEGOTIATION CAPABILITY AND METHOD  
OF NEGOTIATION THEREWITH**

**Cross-reference to Related Applications**

5        This application is related to the following U.S.  
Patent Applications, all of which were filed on even date  
herewith by Bigus et al.: U.S. Serial No. \_\_\_\_\_ entitled  
"APPARATUS AND METHOD FOR COMMUNICATING BETWEEN AN  
INTELLIGENT AGENT AND CLIENT COMPUTER PROCESS USING  
10 DISGUISED MESSAGES," U.S. Serial No. \_\_\_\_\_ entitled  
"APPARATUS AND METHOD FOR OPTIMIZING THE PERFORMANCE OF  
COMPUTER TASKS USING MULTIPLE INTELLIGENT AGENTS HAVING  
VARIED DEGREES OF DOMAIN KNOWLEDGE" and U.S. Serial No.  
\_\_\_\_\_ entitled "APPARATUS AND METHOD FOR OPTIMIZING THE  
15 PERFORMANCE OF COMPUTER TASKS USING INTELLIGENT AGENT WITH  
MULTIPLE PROGRAM MODULES HAVING VARIED DEGREES OF DOMAIN  
KNOWLEDGE." The disclosures of all of these applications  
are hereby incorporated by reference herein.

20        **Field of the Invention**

The invention is generally related to intelligent  
agent computer programs executable on computer systems and  
the like, and in particular, the use of such programs in  
commercial transactions.

25        **Background of the Invention**

Since the advent of the first electronic computers in  
the 1940's, computers have continued to handle a greater  
variety of increasingly complex tasks. Advances in  
30 semiconductors and other hardware components have evolved

to the point that current low-end desktop computers can now handle tasks that once required roomfuls of computers.

Computer programs, which are essentially the sets of instructions that control the operation of a computer to perform tasks, have also grown increasingly complex and powerful. While early computer programs were limited to performing only basic mathematical calculations, current computer programs handle complex tasks such as voice and image recognition, predictive analysis and forecasting, multimedia presentation, and other tasks that are too numerous to mention.

However, one common characteristic of many computer programs is that the programs are typically limited to performing tasks in response to specific commands issued by an operator or user. A user therefore must often know the specific controls, commands, etc. required to perform specific tasks. As computer programs become more complex and feature rich, users are called upon to learn and understand more and more about the programs to take advantage of the improved functionality.

In addition to being more powerful, computers have also become more interconnected through private networks such as local area networks and wide area networks, and through public networks such as the Internet. This enables computers and their users to interact and share information with one another on a global scale. However, the amount of information is increasing at an exponential rate, which makes it increasingly difficult for users to find specific information.



As a result of the dramatic increases in the both complexity of computer programs and the amount of information available to users, substantial interest has developed in the area of intelligent agent computer programs, also referred to as intelligent agents or simply agents, that operate much like software-implemented "assistants" to automate and simplify certain tasks in a way that hides their complexity from the user. With agents, a user may be able to perform tasks without having to know specific sequences of commands. Similarly, a user may be able to obtain information without having to know exactly how or where to search for the information.

Intelligent agents are characterized by the concept of delegation, where a user, or client, entrusts the agents to handle tasks with at least a certain degree of autonomy. Intelligent agents operate with varying degrees of constraints depending upon the amount of autonomy that is delegated to them by the user.

Intelligent agents may also have differing capabilities in terms of intelligence, mobility, agency, and user interface. Intelligence is generally the amount of reasoning and decision making that an agent possesses. This intelligence can be as simple as following a predefined set of rules, or as complex as learning and adapting based upon a user's objectives and the agent's available resources.

Mobility is the ability to be passed through a network and execute on different computer systems. That is, some agents may be designed to stay on one computer system and may never be passed to different machines,

while other agents may be mobile in the sense that they are designed to be passed from computer to computer while performing tasks at different stops along the way. User interface defines how an agent interacts with a user, if  
5 at all.

Agents have a number of uses in a wide variety of applications, including systems and network management, mobile access and management, information access and management, collaboration, messaging, workflow and  
10 administrative management, and adaptive user interfaces. Another important use for agents is in electronic commerce, where an agent may be configured to seek out other parties such as other users, computer systems and agents, conduct negotiations on behalf of their client,  
15 and enter into commercial transactions.

Just as human agents have a certain amount of autonomy, intelligent agents similarly have a set of constraints on what they are authorized and not authorized to do. For example, a selling agent for electronic  
20 commerce applications may be constrained by a minimum acceptable price. However, a good selling agent, whether electronic or human, would never initially give its lowest acceptable price, as this would minimize profit margins. Furthermore, giving the lowest price may not even assure  
25 sales because a buyer may infer that the price is not competitive because the agent is unwilling to lower the price from the original offer. Therefore, an agent typically starts negotiations with some margin from its worst case acceptable price, then works toward a mutually  
30 acceptable price with the other party.

It is desirable for all agents, and particularly those in electronic commerce applications, to operate reliably, efficiently, and profitably on behalf of their clients. Any negotiation plans, techniques or strategies used by an intelligent agent to operate within its constraints, however, often should be hidden from other parties. Otherwise, the agent is placed at a competitive disadvantage. Given that many agents may be dispatched to unsecured environments, an assumption must be made that other parties may be able to scan or reverse engineer an agent to learn its negotiation strategy or other constraints. It must also be assumed that other parties may be able to decode messages sent between an agent and its client to obtain the greatest advantage in negotiation. The validity of such assumptions stems from the fact that these techniques are conceptually similar to many of the techniques used by some salespeople to obtain the best price possible.

If a selling agent uses a predictable algorithm to make offers, e.g., starting with a comfortable margin and halving the difference between the previous asked price and its lowest price with each new asked price, the other party may be able to detect this trend and predict the lowest price acceptable to the agent. Under these circumstances, the selling agent would rarely be able to negotiate a price higher than its minimum acceptable price.

Another desirable trait for intelligent agents is that of efficiency. In electronic commerce applications especially it is often desirable to maximize the number of

trades at the best prices for the client. Any time that an intelligent agent spends in fruitless negotiations decreases the efficiency of the agent.

Furthermore, another concern with intelligent agents arises when the agents are interacting with unknown parties. For example, if agents interact with known, reliable agents, the relative risks to the agents may not be as great, and the agents may not be required to protect against adverse activities on the part of these parties. However, particularly in many unsecured environments, it is likely that the agents will interact with a number of unknown parties, which presents greater risks to the agents, and may require additional protections to be provided for the agent.

In addition, intelligent agents in electronic commerce applications must often be capable of determining a reasonable or acceptable value for a desired transaction. In many markets, especially those that are electronically controlled, market conditions can change rapidly. Stock, bond and commodity prices for example change continuously, and an agent which works with outdated information may enter into transactions that are well outside of the current market conditions at the time of the transactions. Moreover, some markets may be subject to manipulation by other parties attempting to obtain competitive advantages.

Therefore, a significant need exists in the art for an intelligent agent having productive, adaptive, secure and efficient negotiation skills for conducting commercial transactions on behalf of a client.

### Summary of the Invention

The invention addresses these and other problems associated with the prior art in providing an intelligent agent and method of negotiating therewith which utilizes one or more features, alone or in combination, to enhance the productivity, security, efficiency and responsiveness of the agent in negotiations with other parties.

Consistent with one aspect of the invention, the negotiation strategy of agents may be disguised from other negotiating parties to prevent such parties from gaining negotiating advantages at the expense of the agents. Such agents generate offers, wait for responses from negotiating parties, and determine based upon responses whether to complete transactions. A characteristic of at least one of the above steps may be randomized to make the agents' negotiation strategies less predictable, thereby limiting or even precluding negotiating parties from determining the agents' negotiation strategies therefrom.

Consistent with an additional aspect of the invention, the efficiency of some agents may be improved by limiting negotiations that are likely to be unproductive. Such agents generate offers, wait for responses from negotiating parties, and determine based upon the responses whether to complete transactions. Unproductive negotiations with such agents are limited by constraining a characteristic of at least one of the above steps based upon the behavior of the negotiating party and/or the duration of the transaction. Negotiations with suspect or uncooperative parties, or which are prolonged beyond acceptable durations, are more likely to be

terminated, thereby often freeing up the agents to seek more productive negotiations elsewhere.

Consistent with another aspect of the invention, other parties with which an agent interacts may be identified, e.g., to modify the behavior of an intelligent agent depending upon a party with which the agent is interacting. Records of known parties may be maintained with one or more attributes associated therewith, so that upon interaction with an unknown party, the attributes therefor may be compared with those of the known parties to identify the unknown party as that known party for which the attributes most closely match. Identification of another party may have numerous benefits, including but not limited to being able to associate reliability ratings with given known parties so that the reliability of an unknown party may be determined.

Dynamic value determination may also be relied upon to generate a value for a desired transaction, e.g., for the purpose of assisting an agent in calculating offers or determining whether an offer from another party is within an acceptable range for the given goods or services that are the subject of a desired transaction. Consistent with a further aspect of the invention, the desired values of desired transactions may be dynamically determined at least in part by weighting estimated values from a plurality of information sources based upon a predetermined criteria to generate weighted estimated values, and normalizing the weighted values. By utilizing a plurality of information sources, an inherently more reliable value determination may be made for use by an agent in negotiations. Also, in many situations, manipulation of an agent's behavior by third parties may be minimized since value determinations are often not reliant on single sources of information.



Consistent with another aspect of the invention, the desired values of desired transactions may also be dynamically determined at least in part by weighting the values of related transactions based upon the proximity of the related transactions to the desired transactions, and then normalizing the weighted values. The proximity of related transactions may be determined by comparing one or more characteristics of the desired and related transactions such that related transactions that are more similar to the desired transaction are weighted more heavily in the determination of the desired value.

These and other advantages and features, which characterize the invention, are set forth in the claims annexed hereto and forming a further part hereof.

However, for a better understanding of the invention, and of the advantages and objectives attained through its use, reference should be made to the Drawing, and to the accompanying descriptive matter, in which there is described illustrated embodiments of the invention.

### Brief Description of the Drawing

FIGURE 1 is a block diagram of a networked computer system for use with the various embodiments of the invention.

5       FIGURE 2 is a block diagram of one embodiment of the networked computer system of Fig. 1, illustrating the interaction between intelligent agents therein.

FIGURE 3 is a block diagram of one embodiment of the networked computer system of Fig. 1, illustrating the  
10       primary components of the client and remote systems.

FIGURE 4 is a block diagram of an intelligent agent consistent with the principles of the invention.

FIGURE 5 is a flowchart illustrating the program flow of an agent negotiation routine consistent with the  
15       invention.

FIGURE 6 is a flowchart illustrating the program flow of the compute offer price block in Fig. 5.

FIGURE 7 is a flowchart illustrating the program flow of the calculate offer duration block of Fig. 5.

20       FIGURE 8 is a flowchart illustrating the program flow of the complete transaction determination block of Fig. 5.

FIGURE 9 is a flowchart illustrating the program flow of the counteroffer determination block of Fig. 5.

FIGURE 10 is a flowchart illustrating an agent  
25       identification routine consistent with the invention.

FIGURE 11 is a block diagram of the transaction value determination block of Fig. 6.

FIGURE 12 is a block diagram of the history value estimating block of Fig. 11.

FIGURE 13 is a block diagram of the supply and demand value estimating block of Fig. 11.

FIGURE 14 is a flowchart illustrating a high pass filter consistent with the invention.

FIGURE 13

Detailed Description of the Illustrated Embodiments

Turning to the Drawing, wherein like parts are denoted by like numbers throughout the several views, Fig. 1 illustrates a networked computer system 10 for use with the illustrated embodiments of the invention. System 10, which is representative of many networked data processing systems, generally includes one or more computer systems, e.g., single-user computer systems 16, 18 and multi-user computer systems 20, 60, coupled through a network 15.

Multi-user computer system 20 typically includes one or more servers 25 to which one or more single-user computers 22 may be networked through a separate network 24. Similarly, multi-user computer system 60 typically includes one or more servers 65 coupled to one or more single-user computer systems 62 through a network 64. Network 15 may represent any type of networked interconnection, including but not limited to local-area, wide-area, wireless, and public networks (e.g., the Internet).

Intelligent agents are computer programs which have been delegated a degree of autonomy but which are limited to operating within constraints defined by their client. A subset of such agents which are capable of being passed between and operating in different applications or computer systems are referred to as mobile agents.

It is anticipated that agents consistent with the invention may originate in and be resident from time to time on any of the above-mentioned computer systems. One possible distinction between the computer systems for the purposes of the invention may be whether each is a client

or a remote system relative to a particular agent. For example, Fig. 2 illustrates an embodiment of computer system 10 where multi-user computer system 20 is a client system, and multi-user computer system 60 is a remote system.

A client system will hereinafter refer to a computer system that provides an agent a certain level of security from manipulation by other parties when the agent is resident on the system. The client system is also the computer system from which management of the agent is typically handled. The agent typically but not necessarily will also originate from the client system.

A remote system, on the other hand, will hereinafter refer to a computer system that is typically not capable of providing a desired level of security for an agent, generally because the computer system is not under the control of the client. It is typically while resident on a remote system that an agent runs the greatest risk of being scanned or reverse compiled, or of having communications intercepted or monitored, by other parties.

The various embodiments described herein have principal uses in electronic commerce applications, where agents are configured to negotiate commercial transactions, generally in the role of buying or selling agents. The agents may negotiate with other agents, other computer systems, or even other individuals. The agents may interact one-on-one, or may be capable of operating within a "market" of multiple agents, along the lines of a stock or commodity market. Computer systems having the ability to host agents for interaction therebetween

include negotiating programs of varying sophistication and are hereinafter referred to as agent hosts.

For example, Fig. 2 illustrates a mobile intelligent agent 100 which communicates with an agent manager 32 in client system 20. During negotiation with another party such as negotiating agent 95, mobile agent 100 is resident on remote system 60. It should be appreciated that remote system 60 may be the client for agent 95, or may also be considered to be remote relative to this agent as well.

10 An exemplary functional design of networked computer system 10 for implementing the various embodiments of the invention is illustrated in Fig. 3. Server 25 of client system 20 generally includes a central processing unit (CPU) 28 coupled to a memory 30 and storage 40 over a bus 15 54. A local area network interface is provided at 52, and an interface to remote system 60 over external network 15 is provided through interface 50. Agent manager program 32 is resident in memory 30. Storage 40 includes one or more agents 42 (of which may include agent 100, for 20 example), which are computer programs or modules that may be retrieved and used locally within system 20, or dispatched to remote systems to execute and perform tasks on behalf of the client system. Storage 40 also includes an agent mission database 44 which may track agent 25 operations and the relative success or failure thereof.

Server 65 of remote system 60 also includes a CPU 68 coupled to a memory 70, storage 80, external network connection 90 and local network connection 92 over a bus 94. An agent host program 72 is resident in memory 70 to 30 handle interactions between agents resident in the remote



system. Typically, the agent host program is an asynchronous message/event driven environment that provides a common platform over which agent computer programs execute and interact, much like an operating system. The agent host is also capable of permitting messages to be sent between agents and their clients. Memory 70 also includes a negotiating program 74 which operates as the "other party" in transactions with agent 100, which may be another agent, a market or bulletin board application, or even an interface program through which an individual interacts with agent 100. Storage 80 maintains a transaction history database 82 which logs the transactions completed on the server.

Servers 25, 65 may be, for example, AS/400 midrange computers from International Business Machines Corporation. However, it should be appreciated that the hardware embodiments described herein are merely exemplary, and that a multitude of other hardware platforms and configurations may be used in the alternative.

Moreover, while the invention has and hereinafter will be described in the context of fully functioning computer systems, those skilled in the art will appreciate that the various embodiments of the invention are capable of being distributed as a program product in a variety of forms, and that the invention applies equally regardless of the particular type of signal bearing media used to actually carry out the distribution. Examples of signal bearing media include but are not limited to recordable type media such as floppy disks, hard disk drives, and CD-

ROM's, and transmission type media such as digital and analog communications links.

Fig. 4 illustrates agent 100 in greater detail. In general, any agent must have the ability to sense,  
5 recognize and act. Common with many agents, agent 100 includes a number of operational components, including an engine 102 which controls the overall operation of the agent and functions as the "brains" of the agent, a knowledge component 104 in which information is stored  
10 that is representative of the acquired knowledge of the agent, and an adapters component 106 through which the agent communicates with external objects (e.g., host objects 110) and through which the agent "senses" and interacts with its environment. A library component 105  
15 persistently stores in one or more libraries or databases the information utilized by knowledge component 104, while an optional view component 108 provides the human interface, if any, for the agent, e.g., for supplying instructions to the agent.

20 It should be appreciated that all of the modules in agent 100 are typically provided within a single self-sufficient block or package of program code that permits the entire code for the agent to be transmitted to various locations and execute with a degree of autonomy from its  
25 client. Additional data or instructions may also be received by an agent from external sources, e.g., to supplement the library module as necessary. In addition, it should be appreciated that agent 100 may be implemented in practically any programming language, and is  
30 particularly well suited for object-oriented programming

systems by virtue of its at least partially-autonomous operation. For example, agent 100 may be implemented as a Java package, which has a number of benefits for mobile program code by virtue of its platform-independence and  
5 run-time security.

As illustrated in Fig. 4, a number of modules or objects, including agent negotiation module 118 and value determination module 200, are incorporated into engine 102 to handle the negotiation functions for the agent. Module  
10 118 generally implements the negotiation strategy for the agent, while routine 200 is utilized by module 118 to dynamically determine the value of a desired transaction. Each of these modules will be discussed separately herein.

It should be appreciated that other routines or  
15 objects necessary to implement the agent are also included in engine 102 but are not shown herein for ease of illustration. For example, functions such as initialization, communications, maintenance, finding other agents or markets to interact with, etc. may also be  
20 utilized. However, as these functions relate more to the basic operation of an agent, which is in general known in the art, these functions will not be discussed in any greater detail herein.

Moreover, additional functionality may be implemented  
25 by agent 100, e.g., disguising communications between an agent and agent manager, and disguising agent decision logic through the use of neural networking, as described in U.S. Patent Application Serial No. \_\_\_\_\_ entitled  
"APPARATUS AND METHOD FOR COMMUNICATING BETWEEN AN  
30 INTELLIGENT AGENT AND CLIENT COMPUTER PROCESS USING

DISGUISED MESSAGES", which has been incorporated by reference. Agent 100 may also be one of several agents having varying degrees of domain knowledge, or may have multiple modules with varying degrees of domain knowledge, so that the agent may be optimized for operation in different situations based upon an objective criteria (e.g., security concerns), as described in U.S. Patent Application Serial Nos. \_\_\_\_\_ and \_\_\_\_\_, respectively entitled "APPARATUS AND METHOD FOR OPTIMIZING THE PERFORMANCE OF COMPUTER TASKS USING MULTIPLE INTELLIGENT AGENTS HAVING VARIED DEGREES OF DOMAIN KNOWLEDGE" and "APPARATUS AND METHOD FOR OPTIMIZING THE PERFORMANCE OF COMPUTER TASKS USING INTELLIGENT AGENT WITH MULTIPLE PROGRAM MODULES HAVING VARIED DEGREES OF DOMAIN KNOWLEDGE", which have also been incorporated by reference.

#### Agent Negotiation

Agent negotiation with agent negotiation module 118 incorporates a number of separate features usable alone or together to improve the performance of an agent when conducting negotiations. First, one or more operating parameters of the agent may be randomized to an extent to reduce predictability and thus hinder the ability of other parties (e.g., other agents, computer programs, or individuals) to determine the negotiation strategy of the agent. Second, one or more operating parameters of the agent may be constrained to an extent to limit unproductive negotiations, typically based upon the duration of the negotiations and/or the behavior of the

other parties to the negotiations. In addition, in some embodiments, these features, as well as other features discussed below, may obstruct attempts by other parties to manipulate the negotiations.

5        Fig. 5 illustrates an agent negotiation routine 120 which describes the operation of agent negotiation module 118 in greater detail. Routine 120 is generally called when agent 100 has found another party with which to negotiate, and the routine receives a desired transaction,  
10 typically from the agent manager in the client system. Routine 120 has been genericized for either a buying agent or a selling agent, with the distinctions in the routine for each type of agent pointed out below. In general, it should be appreciated that the negotiation strategies for  
15 buying and selling agents differ to the extent that a buying agent's goal is typically to achieve the lowest price possible, while the selling agent's goal is typically to achieve the highest price possible.

20        First, in block 122, a compute offer price block 122 is executed to generate an offer price for a desired transaction. Next, in block 124, an offer at the computed price is issued to another party (e.g., another agent, computer program such as a market, an individual, etc.), typically by sending a message.

25        It should be appreciated that agents typically operate asynchronously, whereby a response message from the other party, if any, may arrive at any time after the offer has been made. Thus, to prevent agent 100 from hanging up waiting for a response that may never arrive,  
30 an offer duration is calculated in block 126 and a timer

is set in block 127 to fix the maximum time for agent 100 to wait for a response.

Next, in block 128, agent 100 waits for the first of the expiration of the timer or the receipt of a response message from the other party. It should be appreciated by those of skill in the art that while agent 100 waits for a response from the other party, the agent may suspend other operations, or may continue performing other operations during the offer duration period. For example, in one embodiment, receipt of a response or expiration of the timer may generate an interrupt which diverts execution of agent 100 to handle the either situation as appropriate. Also, in another embodiment, agent 100 may be multithreaded with a separate thread executing for each negotiation session, whereby each thread may be permitted to simply wait for a response until the timer expires without having to suspend the overall operations of the agent. Moreover, in other embodiments, received responses may be separately logged, with the agent checking for responses only periodically and/or upon expiration of the timer. It should also be appreciated that the offer duration may vary significantly for different applications. For example, in some applications, e.g., stock market transactions, offer durations as short as one or more computer cycles may be possible. In other applications, e.g., real estate transactions, offer durations may be as long as days, weeks, months or longer.

If no response is received within the duration of the offer, control passes to block 130 to withdraw the offer (if necessary) and complete or terminate the negotiation.



An offer may be withdrawn by sending an appropriate message to the other party, removing the offer from a market situation (e.g., if a "bulletin board" of offers has been set up), or simply terminating the negotiation.

- 5 A negotiation complete situation generally indicates that agent 100 is free to wait for other offers from other parties, or to seek out other parties with which to negotiate.

10 If a response message is received from the other party, control passes to block 132 to determine whether to complete the transaction (i.e., make a trade or "close a deal"). If the response message indicates an acceptable response, control passes to block 134 to complete the transaction, e.g., by sending an appropriate message to 15 the other party, notifying an agent host of the transaction specifics, sending a message to the client requesting authorization or indicating that the transaction has been completed, etc.

20 If, however, an unacceptable response is received, control passes to block 136 to determine whether to counteroffer -- that is, whether to continue negotiations. If it is determined that no counteroffer should be made, routine 120, and the negotiation with the other party, is complete. In addition, any messages to the other party, 25 the agent host, and/or the client indicating the completion of negotiations may be made as required.

If a counteroffer is to be made, control passes to block 138 to calculate a wait time before which a counteroffer is to be made, then to block 139 to wait for 30 the calculated period of time before returning control to

block 122 to compute and issue a new offer, or counteroffer. In the alternative, no wait time may be utilized, resulting in an immediate counteroffer being issued.

5           It should be appreciated that agent 100 may conduct negotiations with more than one other party at a time, whereby the program flow similar to that shown in Fig. 5 would be executed for each negotiation session. Each negotiation session may be executed using a separate  
10       execution thread or other context switching mechanism.

          As discussed above, one or more operating parameters of routine 120 are randomized and/or constrained to improve the negotiation performance of agent 100. In the illustrated embodiment of Fig. 5, the computation of the  
15       offer price in block 122, the calculation of the offer duration in block 126, the determination of whether to complete the transaction in block 132, the determination of whether to make a counteroffer in block 136, and the calculation of a wait time in block 138 are randomized to  
20       disguise negotiation strategy and/or are constrained to limit unproductive negotiations. It should be appreciated, however, that randomizing and/or constraining any of these operating parameters may be omitted, and that other operating parameters may be randomized and/or  
25       constrained consistent with the invention.

          The steps performed in compute offer price block 122 are illustrated in greater detail in Fig. 6. Block 122 maintains a record of previous calculations of the value of the desired transaction, as well as previous asked  
30       (selling agent's) prices and previous bid (buying agent's)

prices. These values are used to vary the agent's offer price for each subsequent counteroffer made by the agent.

First, block 140 determines the value (V) of the desired transaction, i.e., what the agent considers to be the actual value of the goods or services being purchased, or what the agent considers to be a "fair" price for its client. One suitable process for determining the value is performed in a value determination module 200 discussed in greater detail below in connection with Figs. 11-13, although other processes may be used in the alternative.

Next, blocks 142 and 144 may be executed to adjust the previous asked (selling agent's) price and previous bid (buying agent's) price in view of any changes to the determined value of the desired transaction. Consequently, if agent 100 detects a significant change between the determined value for the current iteration and for a previous iteration, the values stored for the previous asked and bid prices may be adjusted accordingly to reflect the new value of the transaction. Therefore, for an iteration n of agent negotiation routine 120, blocks 142 and 144 may be represented as:

$$A_{n-1} = A_{n-1,old} + (V_n - V_{n-1})$$

$$B_{n-1} = B_{n-1,old} + (V_n - V_{n-1})$$

where  $A_{n-1}$  is the previous asked price after adjustment,  $B_{n-1}$  is the previous bid price after adjustment,  $A_{n-1,old}$  is the previous asked price prior to adjustment,  $B_{n-1,old}$  is the previous bid price prior to adjustment,  $V_n$  is the current

determined value of the desired transaction, and  $V_{n-1}$  is the previous determined value.

It should be appreciated that blocks 140-144 may not be executed during the first iteration of agent negotiation routine 120. Moreover, it may not be necessary to ever execute these blocks in certain applications, particularly where the negotiations occur over a short time frame and/or the market for the desired transaction is such that variations in the value are not expected during negotiations.

After the previous asked and bid prices are adjusted, an optional block 145 may be executed to attempt to detect the real price of the other party with which negotiations are being conducted. A number of methods of detecting the other party's real price may be used, typically utilizing a curve fitting algorithm to extrapolate the other party's previous offers to find the real price, or the best price (relative to agent 100) at which the transaction may be completed.

For example, another party may attempt to approach the real price by reducing the difference between the current offer and the real price by a fraction each time. By tracking each offer, data points over time may be fit to a curve to minimize mean square error or root mean square error, e.g., with the curve represented by:

$$P_n = R + (P_0 - R) \times e^{-cn}$$

$$E = \sum (Y_n - P_n)^2$$

where  $R$  is the real price,  $Y_n$  are the offers,  $P_n$  are the values for the offers predicted by the curve,  $C$  is a constant, and  $E$  is the error. It should be appreciated that  $R$ ,  $P_0$  and  $c$  are adjusted to minimize the error.

5       The above equations assume that the offers are approaching a constant real price. If the real price is changing over time due to appreciation or depreciation or other factors, the equation for  $P_n$  may be varied accordingly. Also, the equation assumes that the offers  
10 occur at fixed time intervals, and if they do not, the equation may also be varied accordingly by substituting a time variable  $t$  for interval variable  $n$ . The error may also be minimized based upon either or both of the  $n$  and  $t$  domains, with the domain giving the least error used in  
15 detecting the real price.

Other curve fitting techniques may be used in the alternative. Other equations may also be used to compute the predicted value for  $P_n$ . In addition, a neural network may be used to predict the other party's real price. For  
20 example, it would not be uncommon for another party's negotiation strategy to rely on the offers issued by agent 100 when computing the next offer for the party. In such circumstances, the offers issued by agent 100 may also be used as data points to predict the real price. For  
25 example, if agent 100 is a buying agent, the following equations may be used:

$$P_{sn} = R + (P_{s0} - R) \times e^{-cn}$$

$$P_{bn} = R + (R - P_{s0}) \times e^{-cn}$$

30        $E = \sum (Y_{sn} - P_{sn})^2 + \sum (Y_{bn} - P_{bn})^2$

where R is the real price,  $Y_{sn}$  are the sell offers,  $Y_{bn}$  are the buy offers,  $P_{sn}$  are the values for the sell offers predicted by the curve,  $P_{bn}$  are the values for the buy offers predicted by the curve, C is a constant, and E is the error.

On the other hand, if agent 100 is a selling agent, the following equations may be used:

$$\begin{aligned} P_{bn} &= R + (P_{b0} - R) \times e^{-cn} \\ P_{sn} &= R + (R - P_{b0}) \times e^{-cn} \\ E &= \sum (Y_{sn} - P_{sn})^2 + \sum (Y_{bn} - P_{bn})^2 \end{aligned}$$

where R is the real price,  $Y_{sn}$  are the sell offers,  $Y_{bn}$  are the buy offers,  $P_{sn}$  are the values for the sell offers predicted by the curve,  $P_{bn}$  are the values for the buy offers predicted by the curve, C is a constant, and E is the error.

It should be appreciated that the other party's real price may not be detectable, e.g., early in negotiations where sufficient data points have not been obtained, or if a more sophisticated negotiation strategy is being employed. Consequently, the use of the real price in determining the next offer for agent 100 in block 145 may be omitted in these circumstances.

Next, blocks 146 and 148 are executed to calculate (for a buying agent) maximum and minimum bid prices or (for a selling agent) maximum and minimum asked prices. The maximum and minimum prices represent a range of

acceptable prices for which an offer may be made by the agent.

For a buying agent, the maximum and minimum bid prices may be selected to be:

5

$$\max = \text{MIN } (V_n - P, A_{n-1}, R)$$

$$\min = \text{MAX } (V_n - P - M, B_{n-1})$$

where P is the required (or minimum) profit which the agent must obtain to complete the transaction, and M is the negotiating margin used as a starting point for negotiations. Both of these values may be provided as input to the agent and act as constraints on the agent's behavior.

Moreover, it should be noted that the maximum bid price is constrained by the real price, if any, detected for the other party, since at this point it is known that the other party is likely to accept an offer at this price. A margin may also be subtracted from the real price if it is anticipated that the other party may be willing to go below the real price. If the real price is not detected, this term may be dropped from the maximum bid price calculation.

For a selling agent, the maximum and minimum asked prices may be selected to be:

$$\max = \text{MIN } (V_n + P + M, A_{n-1})$$

$$\min = \text{MAX } (V_n + P, B_{n-1}, R).$$



Moreover, it should be noted that the minimum asked price is constrained by the real price, if any, detected for the other party, since at this point it is known that the other party is likely to accept an offer at this price. A margin may also be added to the real price if it is anticipated that the other party may be willing to go above the real price. If the real price is not detected, this term may be dropped from the minimum asked price calculation.

It should be appreciated that on the first iteration of agent negotiation, no previous asked and bid prices exist, and thus, the MIN and MAX functions simplify to their respective remaining terms. On subsequent iterations, however, the range of asked prices decreases, but not below that which would not provide the required profit for the selling agent. Also, the range of bid prices generally increases with each iteration, but never exceeds that which would not provide the required profit for the buying agent.

Next, in block 149, a randomized offer price is calculated for the agent by selecting a random price between the minimum and maximum prices calculated in blocks 146 and 148. For a buying agent, the offer price, or the current bid price, is set to:

$$B_n = \min + \text{random} \times (\max - \min)$$

and for a selling agent, the offer price, or the current asked price, is set to:

$$A_n = \min + \text{random} \times (\max - \min)$$

where random is a random number between 0 and 1.

Therefore, a degree of random noise is added to the offer price computation, thereby hindering detection of the negotiation strategy. Moreover, the range of acceptable prices from which to select is also constrained with each successive iteration. Other pricing strategies may be used in the alternative. For example, the offer price may be selected (for a buying agent) by simply subtracting a fixed amount or a fixed percentage from the last asked price, or (for a selling agent) by adding a fixed amount or fixed percentage to the last bid price. In addition, in lieu of determining a value for the desired transaction, this information could be provided remotely to agent 100 by the agent manager.

Fig. 7 illustrates in greater detail the steps in calculate offer duration block 126 of Fig. 5. In this block, probability functions are used to calculate a random wait time constrained by the number of iterations (cycles) in the negotiation, as well as the last offer received from the other party.

For a buying agent, block 150 is first executed to calculate a wait probability value,  $P_{\text{wait}}$ , between 0 and 1. As shown in the figure,  $P_{\text{wait}}$  is calculated to be the product of two probability functions,  $P_{\text{cycles}}$  and  $P_{\text{asked}}$ .  $P_{\text{cycles}}$  is a function which decreases from 1 to 0 as the number of cycles or iterations increases. For example, where  $C$  is the number of cycles, and  $C_{\text{max}}$  is the maximum

number of negotiation cycles permitted, one suitable function may be:

$$P_{cycles} = 1 - (C/C_{max}).$$

5

Pasked is a function which decreases from 1 to 0 based upon  $A_{n-1}$ , the last asked price received from the other party. The Pasked function may be replaced with a constant value or separate function during the first iteration when no previous asked price exists. Moreover, the Pasked function may be initialized after the first iteration (cycle  $C = 0$ ) to span the range of the minimum bid price calculated,  $min_0$ , to the first asked price from the other party,  $A_0$ . A suitable function may be:

15

$$P_{asked} = 1 - ((A_{n-1} - min_0) / (A_0 - min_0)).$$

For a selling agent, block 152 is instead executed to calculate  $P_{wait}$ . In this block,  $P_{wait}$  is calculated to be the product of  $P_{cycles}$  and  $P_{bid}$ .  $P_{cycles}$  may be the same function as above in block 150.  $P_{bid}$  may be a function which increases from 0 to 1 based upon  $B_{n-1}$ , the last bid price received from the other party. The  $P_{bid}$  function may be replaced with a constant value or separate function during the first iteration when no previous bid price exists. Moreover, the  $P_{bid}$  function may be initialized after the first iteration (cycle  $C = 0$ ) to span the range of the first bid price from the other party,  $B_0$ , to the maximum asked price calculated,  $max_0$ . A suitable function may be:

30

$$Pbid = ((B_{n-1} - B_0) / (max_0 - B_0)).$$

It should be appreciated that Pwait tends to decrease  
 5 as the number of cycles increases. Moreover, Pwait tends  
 to be greater depending upon how "good" the other party's  
 offer is relative to the agent (i.e., for buying agents,  
 lower offers from other parties result in higher Pwait  
 values, and vice versa for selling agents). These  
 10 constraints tend to decrease the offer duration as time  
 increases and/or if the other party does not appear to be  
 converging toward an acceptable price for the agent.

Any of the above functions may utilize different  
 distributions to modify the performance of agent 100. For  
 15 example, different linear, exponential, logarithmic, etc.  
 functions may be utilized for any of Pwait, Pasked and  
 Pbid, and may be implemented as functions, subroutines, or  
 tables. In addition, none of the functions need be  
 continuous or monotonically increasing or decreasing.

20 After execution of block 150 or block 152, control  
 passes to block 154 to create a probability triangle with  
 a base from 0 to 1, with a peak at Pwait, and normalized  
 to an area of 1. Next, in block 156, the triangle is  
 integrated to get a Sigmoid function, and the function is  
 25 subsequently inverted, resulting in a probability  
 distribution that is weighted heavier proximate the value  
 of Pwait. A random number between 0 and 1 is selected in  
 block 157, and this number is input into the derived  
 Sigmoid function in block 158 and used to calculate a

random offer duration time between maximum and minimum wait times,  $\text{wait}_{\text{max}}$  and  $\text{wait}_{\text{min}}$ .

The maximum and minimum wait times are typically selected depending upon the particular circumstances of the market in which the agent interacts (e.g., what is considered an acceptable offer duration in the real estate market is usually different than an acceptable offer duration in the stock market). These times may also be controlled by user input if desired.

It should be appreciated that other probability distributions may be used in the alternative. For example, instead of a probability triangle, other functions which either increase or decrease the distribution around  $P_{\text{wait}}$  may be used. In addition, block 126 may simply calculate a random offer duration with equal distribution in the range of acceptable wait times, or a fixed offer duration may be used. Moreover, an infinite offer duration may be used in some applications. However, block 126 as disclosed herein has the advantage of prolonging the offer duration for more promising negotiations, while shortening the duration when a negotiation does not appear to be as productive.

Fig. 8 illustrates in greater detail the steps in determine whether to complete transaction block 132 of Fig. 5. First, in block 160, the asked price is compared to the bid price. If the asked price is less than or equal to the bid price, this indicates that a suitable price for the transaction has been reached, and accordingly, control is returned to block 134 (Fig. 5) to complete the transaction. If the asked price is still

greater than the bid price, control passes to one of blocks 162 or 164, depending upon whether agent 100 is a buying or selling agent.

For a buying agent, block 162 is executed to  
 5 calculate an accept probability value,  $P_{\text{accept}}$ , which is a number between 0 and 1 that represents the probability that agent 100 will accept the other party's last offer irrespective of the fact that its last offer was not fully agreed to.  $P_{\text{accept}}$  divides a probability range of 0 to 1  
 10 into accept and reject portions, such that a random number selected in this probability range may fall into either the accept or reject portions to control whether the transaction will be completed.

$P_{\text{accept}}$  is calculated as a product of two probability  
 15 functions,  $P_{\text{cycles}}$  and  $P_{\text{asked}}$ .  $P_{\text{cycles}}$  may be an increasing function between 0 and 1, based upon  $C$ , the number of cycles or iterations, and  $C_{\text{max}}$ , the maximum number of cycles permitted in a negotiation:

20 
$$P_{\text{cycles}} = (C/C_{\text{max}}).$$

$P_{\text{asked}}$  may be a function which decreases from 1 to 0 based upon  $A_n$ , the current asked price received from the other party. The  $P_{\text{asked}}$  function may be a function of the  
 25 current asked price between the current and maximum bid prices,  $B_n$  and  $\text{max}$ , calculated in block 122 of Fig. 6. For example, one suitable function may be:

$$P_{\text{asked}} = 1 - ((A_n - B_n) / (\text{max} - B_n)).$$



Consequently, the probability that the transaction will be completed increases over time, as well as depending upon how close the current asked and bid prices are. It should be noted that with this probability function the probability of accepting an offer above the max price calculated in block 122 is zero.

For a selling agent, block 164 is instead executed to calculate  $P_{accept}$  as a product of  $P_{cycles}$  and another probability function,  $P_{bid}$ .  $P_{cycles}$  may be identical to that used in block 162.  $P_{bid}$  may be a function which increases from 0 to 1 based upon  $B_n$ , the current bid price received from the other party. The  $P_{bid}$  function may be a function of the current bid price between the minimum and current asked prices,  $min$  and  $A_n$ , calculated in block 122 of Fig. 6. For example, one suitable function may be:

$$P_{bid} = ((B_n - min) / (A_n - min)).$$

Consequently, the probability that the transaction will be completed increases over time, as well as depending upon how close the current asked and bid prices are. It should also be noted that with this probability function the probability of accepting an offer below the  $min$  price calculated in block 122 is zero. Furthermore, it should be appreciated that any of the above functions may utilize different distributions to modify the overall performance of agent 100, e.g., different linear, exponential, logarithmic, etc. functions, whether implemented as functions, subroutines, or tables. In

addition, none of the functions need be continuous or monotonically increasing or decreasing.

Next, a random number within a probability range of 0 to 1 is selected in block 166. This number is compared to  
 5 Paccept in block 168. If the random number is less than or equal to Paccept, the last offer from the other party is accepted and control is passed to block 134 of Fig. 5. If the random number is greater than Paccept, the last offer is rejected, and control passes to block 136 of Fig.  
 10 5 to determine whether a counteroffer should be made.

Other rules for completing a transaction may be used in the alternative. For example, a buying agent may be configured to accept any offer that is less than the initial asked price, or to accept only offers for the bid  
 15 price or lower, or to accept any offer less than the maximum bid price. Similarly, a selling agent may be configured to accept any offer that is greater than the initial bid price, or to accept only offers for the asked price or higher, or to accept any offer greater than the  
 20 minimum asked price.

Fig. 9 illustrates in greater detail the steps in determining whether to counteroffer block 136 of Fig. 5. If agent 100 is a buying agent, block 170 is executed to calculate a counteroffer probability value, Pcounter,  
 25 which is a number between 0 and 1 that represents the probability that agent 100 will continue negotiations by making a counteroffer. Pcounter divides a probability range of 0 to 1 into counteroffer and no counteroffer portions, such that a random number selected in this

probability range may fall into either the portions to control whether a counteroffer will be made.

Pcounter is calculated as a product of two probability functions, Pcycles and Pasked. Pcycles may be a decreasing function between 0 and 1, e.g., as with the Pcycles functions utilized in blocks 150 and 152 of Fig. 7. Pasked may be a function which decreases from 1 to 0 based upon  $A_n$ , the current asked price received from the other party. For example, one suitable function may be:

$$Pasked = 1 - ((A_n - B_n) / (A_{max} - B_n))$$

where  $A_{max}$  is a value that is typically greater than max and that represents the maximum asked price for which a counteroffer should be considered.  $A_{max}$  may be, for example, a fixed percentage or constant above max, and may operate, for example, to detect frivolous offers that are beyond what should be expected for reasonable offers from another party.

Consequently, the probability that a counteroffer will be made decreases over time to attempt to limit unproductive negotiations. Also, the probability that a counteroffer will be made increases depending upon how close the current asked and bid prices are.

For a selling agent, block 172 is instead executed to calculate Pcounter as a product of Pcycles and another probability function, Pbid. Pcycles may be identical to that used in block 170. Pbid may be a function which increases from 0 to 1 based upon  $B_n$ , the current bid price

received from the other party. For example, one suitable function for Pbid may be:

$$Pbid = ((B_n - B_{min}) / (A_n - B_{min})).$$

5

where  $B_{min}$  is a value that is typically less than min and that represents the minimum bid price for which a counteroffer should be considered.  $B_{min}$  may be, for example, a fixed percentage or constant below min, and may  
 10 operate, for example, to detect frivolous offers that are beyond what should be expected for reasonable offers from another party.

As with blocks 150, 152, 162 and 164, any of the above functions in blocks 170 and 172 may utilize  
 15 different distributions to modify the overall performance of agent 100, e.g., different linear, exponential, logarithmic, etc. functions, whether implemented as functions, subroutines, or tables. In addition, none of the functions need be continuous or monotonically  
 20 increasing or decreasing.

Next, a random number between 0 and 1 is selected in block 174. This number is compared to Pcounter in block 176. If the random number is less than or equal to Pcounter, a counteroffer will be made, and control is  
 25 passed to block 138 of Fig. 5. If the random number is greater than Pcounter, no counteroffer will be made, and the negotiation may be terminated.

Other manners of determining whether to make a counteroffer may be used. For example, counteroffers may  
 30 always be made or never be made. In addition,

counteroffers may be made only for a fixed number of cycles. Other alternatives will be apparent to one skilled in the art.

Returning to Fig. 5, block 138 may also be randomized to disguise the negotiation strategy of agent 100. Block 138 may calculate a wait time by retrieving a random number to select between a range of acceptable wait times, specified by min time and max time, each of which may be selected based upon the particular market characteristics within which the agent operates. A suitable function may be:

$$\text{wait time} = \text{min time} + (\text{max time} - \text{min time}) \times \text{random\#}$$

In the alternative, a constant wait time (even zero) may be used for block 138. In addition, a weighted function, similar to the offer duration calculation, may also be performed to vary the wait time in view of the duration of the negotiation and/or the behavior of the other party.

In general, it should be appreciated that randomization may be performed on any number of operational parameters or characteristics related to the negotiation strategy of agent 100, which effectively hinders the ability of other parties to detect the negotiation strategy of the agent.

Also, a party's unpredictability in negotiations often leads to a more favorable outcome for the party because another party may be less likely to risk missing out on the transaction. For example, if it was known that agent 100 routinely sets an offer duration of five days,

another party knowing this may seek better offers for four days, knowing that the original offer will still be available. However, if the offer duration is not known, the other party may simply accept the offer rather than risk losing it.

Moreover, it should be appreciated that any number of operational parameters or characteristics may be constrained in the manner disclosed above based upon a variety of factors including duration of negotiation and behavior of another party. This provides a degree of stability for the agent since less productive negotiations are on the average terminated more quickly to enable the agent to seek more productive negotiations elsewhere. In addition, this may reduce manipulation by other competing parties which may attempt to tie the agent up with frivolous negotiations while the other parties complete transactions to the detriment of the agent.

The behavior of agent 100 may also be constrained based upon the identification of another party or the perceived reliability or legitimacy of the other party, with a suitable probability function developed to limit negotiations with unreliable or unknown parties relative to known valid parties. For example, one suitable manner of identifying another agent is illustrated by agent identification routine 180 in Fig. 10. With this routine, a database of known agents may be utilized, with characteristics of an unknown agent compared against the database to match an unknown agent to one of the unknown agents.



Routine 180 begins at block 181 by collecting information about an unknown agent in the form of one or more attributes. For example, routine 180 may attempt to obtain such information on an unknown agent as its name or identification, its client, bank and/or bank account number, its homebase location (e.g., IP address or domain), the name or identification of the agent program, the size of the agent program, where messages and other communications with the agent originate, and/or the pattern of input/output (I/O) compared to CPU cycles for I/O transmissions. Also, routine 180 may attempt to retrieve a credit card number or bank account number from the unknown agent and validate the number. Moreover, the unknown agent may be scanned and compared to other known agents, e.g., comparing the percentage of identical code, determining the language the agent was written in, or searching for unique patterns in much the same manner as a virus checking program.

Whatever attributes are selected for analysis of unknown agents, each factor is assigned a weighting factor such that the sum of all weighting factors equals one. Then, in blocks 182-186, a loop is executed to compare all of the attributes retrieved for the unknown agent against a known agent stored in the database. In block 182, the attributes for a known agent are retrieved, and in blocks 183-186, each attribute for the unknown agent is compared with the corresponding attribute for the known agent. If any attributes match, their corresponding weighting factors are accumulated by block 185.

Next, in block 187, the accumulated weighting factor is compared with a minimum threshold that represents the smallest weighting factor that could indicate a match with a known agent. If the threshold is exceeded, block 188  
 5 compares the accumulated weighting factor with the previous maximum for the agent being analyzed (which is initially set to zero). If the accumulated weighting factor exceeds the previous maximum (indicating a more likely match), the identification of the known agent and  
 10 the accumulated weighting factor are stored as the new maximum in block 189. If either the minimum threshold or the previous maximum are not exceeded, block 189 is skipped.

Next, block 190 determines whether the unknown agent  
 15 must be compared to any additional known agents in the database. If so, control passes to block 182 to compare the unknown agent to the next known agent in the database. If all known agents have been processed, control passes to block 191 to report the known agent identification and  
 20 accumulated weighting factor therefor before terminating the routine.

In some embodiments of the invention, some of the records of known agents may represent categories of known agents, where one or only a few attributes are emphasized.  
 25 This would permit, for example, agents that emanated from a known corrupt domain to be specially handled irrespective of other attributes, among other special situations.

Based upon the information provided by routine 180, a  
 30 negotiation routine consistent with the invention may be

able to classify an unknown agent as valid, corrupt, unknown, or may define a distribution of reliability from valid to corrupt. Based upon this classification, one or more negotiation characteristics may be constrained as

5 above with routine 120, or even terminated immediately in some applications. In addition, the results of a negotiation with a particular agent may be fed back to the database of known agents to modify the reliability of the known agents and thereby expand and improve the database

10 as the agent gains experience. For example, a neural network could be used to generate a reliability rating for an agent based upon the learned behavior of known agents.

Other functionality to the described agent negotiation routine may be made consistent with the

15 invention. Moreover, it should be appreciated that any of the above functionality may be shifted to the agent manager, whereby part or none of the negotiation strategy is resident in the agent, and therefore the agent operates to a greater extent as a intermediary between the agent

20 manager and the other party.

#### Value Determination

The value of a desired transaction may be determined dynamically by agent 100 in part by combining value

25 estimates from one or more sources of information. Multiple value estimates may be combined, for example, by taking the weighted average of the value estimates, although other methods may be used consistent with the invention. Moreover, as will be discussed in greater

30 detail below, the value of a desired transaction may also

be determined at least in part by generating a value estimate from a plurality of related transactions, whether current or past transactions, based upon their proximity to a desired transaction. By comparing one or more  
5 characteristics of the desired and related transactions, related transactions that are more similar to the desired transaction are weighted more heavily and therefore are more prominently reflected in the determination of the value estimate.

10 The valuation process described herein may be performed once for a negotiation, or may be performed as often as once each iteration in a negotiation, to ensure that the latest information is used to obtain the best deal for the client. From the value retrieved from this  
15 process, an offer price may be determined by adding or subtracting a negotiating margin and/or required profit margin as appropriate.

Fig. 11 illustrates a dynamic value determination module 200, which includes and maintains four databases  
20 which provide four types of sources of information for estimating the value of a desired transaction input to the module. As will become more apparent from the discussion below, different databases may have greater applicability to different markets, as well as different goods and  
25 services, and thus, the four databases disclosed herein may not be required for all applications. Other types of databases may also be relied upon consistent with the invention.

A first database, base values and delta values  
30 database 202, is analogous to an automotive buyers guide,

where goods have base values which may be adjusted by delta values depending upon one or more optional features for the particular goods. For example, with an automotive buyers guide, automobiles may have base wholesale and retail prices, with delta prices for adjusting the base prices depending upon mileage and optional equipment.

A second database, rules for computing value database 204, may be used for more complicated applications where values may not be defined with a simple database such as database 202. For example, for real estate, a suitable database may be implemented with rules such as price per square footage, location information and style of house, plus variable additions and subtractions for certain characteristics. Rules-based databases are in general known in the art, and may vary greatly depending upon the particular goods and services, and/or market involved.

A third database, history of transactions database 206, maintains a record of past transactions, including the price of the transaction as well as such descriptive information as the type, quantity, and time of the transaction, as well as the parties involved in the transaction. A fourth database, current market status database 208, maintains current market information, including the current prices (e.g., asked and bid prices) for certain transactions, as well as any limitations on the prices such as quantity and other descriptive information. The current market information includes a record of current transactions, which may include recent completed transactions and/or uncompleted transactions such as outstanding buy and sell offers.

Databases 202 and 204 are often fairly stable and may need only be updated periodically from an external source (e.g., many automobile buyers guides are updated monthly, quarterly or yearly). However, databases 206 and 208 are  
5 often more dynamic and may need to be updated almost continuously to provide agent 100 with the latest information possible.

In the illustrated embodiment, updating of databases 206 and 208 is performed via a separate market monitoring  
10 agent 260, which may obtain information via maintaining a transaction history for all agents at a home base, snooping on a network such as the Internet, accessing public sources such as libraries, newspaper, financial market or government records, etc. It should be  
15 appreciated that market monitoring may also be handled by the agent manager in the client system, or even by agent 100 itself. Market monitoring agent 260 would operate principally as a data mining or information retrieval agent. The operation of such monitoring agents is  
20 generally known in the art, and therefore agent 260 will not be described in any greater detail herein.

Based upon the information from databases 202-208, value estimates for a desired transaction may be obtained from one or more of four value estimators. The desired  
25 transaction input to module 200 typically includes descriptive information for a transaction such as quantity, features, and other characteristics that describe the transaction in greater detail and permit some value estimates to be specifically tailored for particular  
30 transactions.



A first value estimate relies on a sum base and delta values block 211 which retrieves the base and delta values from database 202 that most approximate the desired transaction. Block 211 then sums the retrieved values to arrive at the first value estimate.

A second value estimate relies on an expert system 210 for computing values from the information retrieved from either or both of databases 202, 204. Expert system 210 also may optionally receive a value estimate from either or both of value estimators 215, 220 which are discussed in greater detail below, and may itself provide its value estimate to value estimators 215, 220. The implementation, development and training of an expert system for expert system 210 is in general known in the art, and any number of commercial expert system development packages may be used consistent with the invention. Moreover, the particular configuration of expert system 210 may vary greatly depending upon the market and goods/services for which agent 100 is optimized to negotiate.

Either of the first and second value estimates may be selected at a time as illustrated by OR gate 212, e.g., depending upon the price range and asset category of the goods or services which are the subject of the transaction. In the alternative, both value estimates may be utilized at the same time.

A third value estimate may be obtained using a comparable transaction value estimator 215 which receives input from database 206, as well as from database 202 and expert system 210. In general estimator 215 compares past

transactions with the desired transaction and generates for each past transaction (with the exception of any filtered out transactions) an estimated value based upon the proximity of the past transaction to the desired transaction. This is primarily accomplished through standardizing the past transactions in view of the characteristics of the desired transaction. The estimated values are then weighted and summed by blocks 232-240 as discussed below.

10 Estimator 215 is illustrated in greater detail in Fig. 12. Descriptions and prices for past transactions are received from database 206 through an optional filter 207 (discussed below). The description for a past transaction is compared to the description of the desired transaction in difference block 216, resulting in one or more delta description signals representative of the proximity or relatedness of the past and desired transactions (e.g., quantity, time, type, etc.). The delta description is supplied to database 202 and expert system 210, which in turn supplies a delta value representative of the descriptive changes between the past and desired transactions. The delta description may also be output as one or more proximity of transaction signals for weighting value estimates.

25 For example, for the purchase of an automobile, if a past transaction is for an automobile which is identical except for leather seats, a delta value representative of the value of the leather seats may be output to correct the value of the past transaction to remove the value of the leather seats, thereby standardizing the past

30

transaction to the characteristics of the desired transaction. Similar corrections may be made for other distinguishing characteristics between the past and desired transactions.

5 A delta value is also output by database 202 and passed to an optional extrapolation block 217. Block 217 calculates an alternate delta value to correct for time variations in applications where the value of goods or services varies (i.e., appreciates and/or depreciates)  
10 over time (e.g., with stocks, automobiles, real estate, etc.)

For example, block 217 may maintain a record of the prices and times for all past transactions for particular goods or services. Individual records may first be  
15 standardized based upon the delta values provided by database 202. From the standardized past transactions, a curve fitting or other routine may be utilized to temporally extrapolate, or develop a trend for the value of the goods over time. The trend may then be used to  
20 correct the value of past transactions for current market conditions. As such, any depreciation or appreciation of the goods over time is accounted for in the delta value output from block 217.

The delta value outputs of expert system 210 and  
25 extrapolation block 217 are selectively output from an OR gate 218 depending upon the particular application, market and type of goods or services. In the alternative, the two outputs may be weighted and averaged to generate a single delta value. Regardless, the delta value output  
30 from gate 218 is passed to summation block 219 and is

added to the price for the past transaction to generate a standardized value estimate for the past transaction.

As mentioned above, past transactions may be passed through an optional filter 207 to remove unreliable transactions from the value estimation and thereby hinder manipulation attempts by other parties. This may be performed in addition to, or in lieu of, weighting each past transaction as discussed below.

For example, transactions involving known unreliable or corrupt agents, or involving the agent with which agent 100 is currently negotiating, may be filtered out. In addition, to prevent another party from entering into a number of small transactions to affect the market value of a transaction, low volume transactions below a certain threshold may be omitted. Moreover, open (unaccepted) offers may be filtered out, as may outlying transactions which fall well outside of the trend of past transactions. Particularly for supply and demand value estimator 220 discussed below, open offers which are outside of the trend of past transactions may be discarded. Other inherently less reliable transactions may also be filtered out consistent with the invention.

Returning to Fig. 11, the value estimate for each past transaction in database 206 is weighted by a series of weighting blocks 232, 234, 236 and 238 based upon the proximity or similarity of the past transaction and the desired transaction. Any number of characteristics may be used to weight the transaction, including proximity in time (to emphasize recent transactions), similarity in type (to emphasize transactions for similar features,

etc.), quantity (to emphasize larger transactions), and reliability (to de-emphasize transactions with extraneous circumstances).

In the illustrated embodiment, weighting blocks 232 and 234 receive the delta description value outputs from estimator 215 to weight the estimated value depending upon its similarity in type and its proximity in time to the desired transaction. Accordingly, more recent transactions are emphasized, as are transactions that are more similar in type to the desired transaction.

Weighting block 236 receives the quantity of the past transaction to emphasize (weight more heavily) transactions for larger quantities. In addition, weighting block 238 receives a reliability signal related to the reliability of the past transaction. This signal may be obtained, for example, by identifying the agents involved in the past transaction (e.g., with routine 180 discussed above with reference to Fig. 10). Transactions with unreliable agents, or with the same party as is involved in the current negotiation, may be de-emphasized to maintain the integrity of the value estimate.

The weighted value estimates output from blocks 232-238 are summed together and normalized in block 240. The output of this block is a single value estimate based upon all or at least a portion of the past transactions in database 206.

A fourth value estimate may be obtained using a supply and demand value estimator 220 which receives input from database 208 and expert system 210. In general estimator 220 compares current buy and sell offers with

the desired transaction and generates for each offer an estimated value based upon any differences between the offer and the desired transaction. This is primarily accomplished through standardizing the offers in view of the characteristics of the desired transaction.

Estimator 220 is illustrated in greater detail in Fig. 13, where a comparable transaction value estimator 221 receives current sell and buy offers from database 208. The sell and buy offers are separately weighted based upon their proximity to the desired transaction, then are summed and normalized to generate a range from which the value estimate may be obtained.

Estimator 221 is similarly configured to estimator 215, except that current offers are compared to the desired transaction, rather than past transactions. It should be noted that estimator 221 may also be interconnected with database 202 and expert system 210 as with estimator 215; however, the signal paths therefor are omitted in Fig. 13 for clarity.

Sell offers are weighted by a plurality of weighting blocks 222, 223 and 224, then are summed and normalized in block 225. Similarly, buy offers are weighted by a plurality of weighting blocks 226, 227 and 228, then are summed and normalized in block 229. Control over weighting blocks 222 and 226 is provided by estimator 221, which supplies a weighting signal based upon the similarity in type between each offer and the desired transaction, thereby emphasizing more related offers. Control over weighting blocks 223 and 227 is also provided by estimator 221, which supplies a weighting signal based



upon the quantity of each offer, thereby emphasizing larger quantity offers. Control over weighting blocks 224 and 228 is provided by a reliability signal, e.g., that provided to block 238 in Fig. 11, to de-emphasize  
5 unreliable offers such as from unreliable agents or from the same agent with which negotiations are currently in progress.

The outputs of blocks 225 and 229 typically represent minimum and maximum values for a range, since sell offers  
10 are typically lower on average than buy offers. The outputs are provided to a determine value from range block 230 which outputs the value estimate based upon current market conditions. Block 230 may operate in a number of manners to select a value within the range of buy and sell  
15 offers. For example, block 230 may take the midpoint of the range, or may take the maximum or minimum of the offers depending upon whether agent 100 is a buying or selling agent. A more favorable price may be selected (e.g., the maximum for a selling agent, and the minimum  
20 for a buying agent). In the alternative, since profit and negotiating margins are added in the offer calculation, the less favorable price may be used (e.g., the minimum for a selling agent, and the maximum for a buying agent). In addition, the outputs of blocks 225 and 229 may be  
25 weighted according to the number of buy and sell offers, or may be weighted inversely to grant equal weights to buy offers and sell offers. Other manners of selecting the value estimate may be used in the alternative.

A number of modifications to estimator 220 may be  
30 made consistent with the invention. For example, the

weighted averages of buy and sell offers may be replaced by a minimum of all sell offers and a maximum of all buy offers. In addition, a single weight and normalize step may be used on both the buy and sell offers. Moreover, 5 buy and sell offers may be filtered as above for past transactions to limit the types of offers considered in the estimate calculation.

Returning to Fig. 11, the value estimates output from estimators 215 and 220 and OR gate 212 are supplied to a 10 weighting block 250 including a separate weighting block 252, 254 and 256 for each value estimate. Each weighting block is controlled via a relative weight input to module 200, where the weights to the three blocks 252, 254 and 256 total 1. The weighted value estimates are then summed 15 in block 258 to arrive at the final value estimate.

The relative weights applied to the various value estimates may vary depending upon the particular goods or services and markets. Moreover, it is anticipated that such weights may be determined empirically for different 20 applications, or may be selected by a user. In the alternative, one or more of the value estimates may be disregarded, e.g., if a value estimate differs from the other two value estimates by greater than a certain percentage, or if one or more value estimates is deemed 25 unreliable due to either a small number of comparable transactions or to all transactions having a relatively low similarity.

The value estimates from past transactions and/or current buy and sell offers may be protected against 30 manipulation in a number of manners. By weighting

multiple past transactions and/or sell and buy offers, the relative effect of single transactions is minimized.

Moreover, transactions for larger quantities are emphasized, thereby minimizing the effects of small

5 transactions that may be made solely for the purpose of affecting the market. Also, through the filtering techniques discussed above, unreliable transactions from known corrupt agents or from the same agent which agent 100 is currently negotiating with may be filtered out, as 10 may transactions and open offers which are well outside of the trend of the market. Furthermore, if the value estimate from past transactions differs greatly from the value estimate from current sell and buy offers (where what a significant difference is may vary based upon the 15 particular market or upon history), the value estimate from the current offers may be thrown out as being unreliable.

It may also be possible to determine a reliability of the value estimate for past transactions and/or current 20 sell and buy offers, e.g., through computing the average weight of the top n transactions used in the value estimate and the number of transactions used in the average. If the number or the weight is less than expected, the reliability of the estimate may be 25 questionable and the behavior of the agent may be modified (e.g., by weighting the value estimate from database 202 or from expert system 210 more heavily). In the alternative, the reliability may be determined by treating the weights of all the transactions or offers as 30 distributions, then using statistical techniques such as

average weight, number of points in distribution and standard deviation to determine the reliability.

Various modifications may be made to the illustrated embodiments without departing from the spirit and scope of the invention. For example, any of the above value estimators, weighting blocks and normalizing blocks in module 200 may be implemented using neural networks. Also, a number of variables and functions, such as the maximum and minimum wait times, required profit and negotiating margins, probability functions, and weighting of value estimates, among others, may be controlled by a user.

In addition, a high pass filter may be used in a separate monitoring module in agent 100 to detect strong changes in the market and at least temporarily alter the negotiation strategy of the agent. Transactions are monitored as they occur, and a slope related to the differences in prices between one or more subsequent transactions is calculated in a known manner. Large positive or negative slopes therefore indicate fastly rising or falling prices.

The trend of rising or falling prices is typically monitored over several transactions to ensure that intermittent deviations do not necessarily indicate a volatile market. The filter may be made less susceptible to manipulation by eliminating small transactions for quantities below a predetermined minimum, or by averaging the price over enough small transactions to make the predetermined minimum.

As a result of a volatile market condition, the negotiation strategy of agent 100 may be overridden, e.g., to withdraw pending offers that are now worse for the client than is now available in the market, or to immediately accept pending offers without delay should they be better for the client than is now available in the market. The agent may also withdraw from trading until the volatility decreases. Probability functions may also be modified, for example, to make the agent more or less conservative depending upon market volatility.

A high pass filter may also be used to override any "stop losses" or "stop gains" issued to the agent. A "stop loss" relates to an instruction to sell a product at a certain price below the current market price if the market ever drops to that price. However, in a volatile market where market prices may drop rapidly, the market may drop below this price before the stop loss transaction can be completed. A similar situation may occur for "stop gain" transactions issued when a client is selling short, when a market is rising faster than the stop gain transaction can be completed.

By using the slope calculation from the high pass filter, a market low (or high) point, represented by a change in slope from negative to neutral or positive (or from positive to neutral or negative) over a number of transactions, may be detected and used to lock out stop loss (or stop gain) transactions. This would effectively prevent a sale from being made at the bottom (or top) of the market, when the market trend has reversed. The slope

calculation may be performed on a per transaction or per elapsed time basis.

For example, one suitable high pass filter 270 having stop loss/gain protection is illustrated in Fig. 14.

5 First, a new transaction is retrieved in block 272. Either of history of transaction database 206 and current market databases 208 may be utilized in this operation, or filter 270 may separately monitor a market, or may receive updates from market monitoring agent 260 (Fig. 11).

10 The slope relative to a previous transaction is calculated in block 274. Next, block 275 determines whether the slope has exceeded a certain threshold for n transactions, indicating a volatile market condition. Typically, two or more slope calculations are used to  
15 minimize transient variations. The threshold will vary depending upon the particular goods/services and market.

If a volatile market condition has been detected, control passes to block 276 to notify agent 100, whereby the agent negotiation strategy may be modified as  
20 discussed above. Control then passes to block 277. If no volatile market condition is detected, control passes directly to block 277.

Block 277 detects whether the slope has changed sign or turned neutral relative to a previous slope over m  
25 transactions, indicating that the market has bottomed out (when going from a negative to neutral or positive slope) or crested (when going from a positive to neutral or negative slope). Slope computations over multiple transactions may be considered in this operation to  
30 minimize the effects of transient variations. If the



slope has changed, the agent may be notified in block 279 to temporarily lock out any stop loss/stop gain transactions. Alternatively, stop loss transactions may be locked out only in response to a negative to positive or neutral slope change, and stop gain transactions may be locked out only in response to a contrary change. After the transactions are locked out, control returns to block 272 to process the next transaction.

Returning to block 277, if the slope has not changed, control passes to block 278 to determine whether the transaction price has fallen significantly below the stop loss price, or has risen significantly above the stop gain price. If so, control passes to block 279 to temporarily lock out any stop loss/stop gain transactions, as discussed above. If not, control returns to block 272 to process the next transaction. It should be appreciated that block 278 may also be implemented by utilizing a range of prices for the stop loss and/or stop gain.

Other modifications will be apparent to one skilled in the art. Therefore, the invention lies solely in the claims hereinafter appended.

## WHAT IS CLAIMED IS:

1           1. A method of conducting an electronic transaction  
2 with an intelligent agent, the method comprising the steps  
3 of:

4           (a) generating an offer to enter into a  
5 transaction;

6           (b) waiting for a response from a negotiating  
7 party;

8           (c) upon receiving a response, determining  
9 whether to complete the transaction; and

10          (d) disguising a negotiation strategy from the  
11 negotiating party by randomizing a characteristic of  
12 at least one of the generating, waiting and  
13 determining steps.

1           2. The method of claim 1, further comprising the  
2 step of limiting unproductive negotiations by constraining  
3 a characteristic of at least one of the generating,  
4 waiting and determining steps based upon at least one of a  
5 behavior of the negotiating party and a duration of the  
6 transaction.

1           3. The method of claim 1, wherein the offer  
2 generating step includes the steps of determining a value  
3 for a desired transaction and calculating a range of  
4 acceptable offer prices from the value, and wherein the  
5 disguising step includes the step of selecting for the  
6 offer a random price within the range of acceptable offer  
7 prices.

1        4. The method of claim 3, wherein the value  
2 determining step includes the steps of:

3            (a) retrieving a plurality of related  
4 transactions that are related to the desired  
5 transaction, each related transaction having a value  
6 associated therewith;

7            (b) for each related transaction, weighting the  
8 value of the related transaction based upon a  
9 proximity between the related and desired  
10 transactions to obtain a weighted value; and

11           (c) normalizing the weighted values to generate  
12 the value for the desired transaction therefrom.

1        5. The method of claim 3, wherein the value  
2 determining step includes the steps of:

3            (a) generating a plurality of estimated values  
4 from a plurality of information sources;

5            (b) weighting the plurality of estimated values  
6 based upon a predetermined criteria to generate a  
7 plurality of weighted estimated values; and

8            (c) normalizing the plurality of weighted  
9 estimated values to generate the value for the  
10 desired transaction therefrom.

1        6. The method of claim 3, wherein the offer  
2 generating step further comprises the steps of:

3            (a) storing previous asked and bid prices; and

4            (b) adjusting the previous asked and bid prices  
5 in response to a change in the value of the desired  
6 transaction.

1        7. The method of claim 3, wherein the agent operates  
2 as a selling agent, and wherein the calculating the range  
3 of acceptable prices step includes the steps of:

4            (a) selecting a minimum offer price from the  
5 maximum of (1) a previous asked price and (2) the  
6 value of the desired transaction plus a required  
7 profit margin; and

8            (b) selecting a maximum offer price from the  
9 minimum of (1) a previous bid price and (2) the value  
10 of the desired transaction plus the required profit  
11 and a negotiating margin.

1        8. The method of claim 3, wherein the agent operates  
2 as a buying agent, and wherein the calculating the range  
3 of acceptable prices step includes the steps of:

4            (a) selecting a minimum offer price from the  
5 maximum of (1) a previous bid price and (2) the value  
6 of the desired transaction less a required profit  
7 margin and less a negotiating margin; and

8            (b) selecting a maximum offer price from the  
9 minimum of (1) a previous asked price and (2) the  
10 value of the desired transaction less the required  
11 profit.

1        9. The method of claim 3, wherein the offer  
2 generating step further comprises the steps of:

3            (a) detecting a real price for the negotiating  
4 party; and

5            (b) constraining the range of acceptable offer  
6 prices using the real price.

1        10. The method of claim 1, wherein the waiting step  
2 includes the step of selecting a random wait time between  
3 maximum and minimum offer duration times.

1        11. The method of claim 10, wherein the waiting step  
2 further includes the step of calculating a wait  
3 probability value based upon the duration of the  
4 transaction and a last offer received from the negotiating  
5 party.

1        12. The method of claim 11, wherein the waiting step  
2 further includes the step of generating a probability  
3 distribution from the wait probability value, and wherein  
4 the step of selecting a random wait time selects a random  
5 point in the probability distribution when selecting a  
6 wait time between the maximum and minimum offer duration  
7 times.

1        13. The method of claim 1, wherein the step of  
2 determining whether to complete the transaction includes  
3 the steps of:

4            (a) completing the transaction if an asked  
5 price from one of the offer and the response is less  
6 than or equal to a bid price from the other of the  
7 offer and the response;

8            (b) determining an accept probability value  
9 based upon the duration of the transaction and the  
10 proximity of the offer and response, the accept  
11 probability value dividing a probability range into  
12 accept and reject portions;

13           (c) selecting a random number within the  
14 probability range; and

15           (d) completing the transaction if the random  
16 number falls within the accept portion of the  
17 probability range.

1       14. The method of claim 1, further comprising the  
2 step of determining whether to make a counteroffer,  
3 wherein the disguising step includes the step of  
4 randomizing a characteristic of the determining whether to  
5 make a counteroffer step.

1       15. The method of claim 14, wherein the determining  
2 whether to make a counteroffer step includes the steps of:

3           (a) determining a counteroffer probability  
4 value based upon the duration of the transaction and  
5 the proximity of the offer and response, the  
6 counteroffer probability value dividing a probability  
7 range into counteroffer and no counteroffer portions;

8           (b) selecting a random number within the  
9 probability range; and

10          (c) making a counteroffer if the random number  
11 falls within the counteroffer portion of the  
12 probability range.

1       16. The method of claim 15, further comprising the  
2 step of wait for a randomized time period prior to making  
3 a counteroffer.



1        17. The method of claim 1, further comprising the  
2 steps of monitoring transactions with a high pass filter  
3 that calculates a market slope to detect volatile market  
4 conditions, and adjusting the negotiation strategy upon  
5 detection of volatile market conditions.

1        18. The method of claim 17, further comprising the  
2 step of locking out at least one of stop loss and stop  
3 gain offers in response to an inversion of the market  
4 slope calculated by the high pass filter.

1        19. An apparatus for conducting an electronic  
2 transaction, the apparatus including an intelligent agent  
3 computer program executed by the apparatus, the  
4 intelligent agent including an agent negotiation module  
5 configured to perform the method steps of:

6            (a) generating an offer to enter into a  
7 transaction;

8            (b) waiting for a response from a negotiating  
9 party;

10           (c) upon receiving a response, determining  
11 whether to complete the transaction; and

12           (d) disguising a negotiation strategy for the  
13 intelligent agent from the negotiating party by  
14 randomizing a characteristic of at least one of the  
15 generating, waiting and determining steps.

1        20. The apparatus of claim 19, wherein the agent  
2 negotiation module is further configured to execute the  
3 step of limiting unproductive negotiations by constraining

4 a characteristic of at least one of the generating,  
5 waiting and determining steps based upon at least one of a  
6 behavior of the negotiating party and a duration of the  
7 transaction.

1 21. The apparatus of claim 19, wherein the  
2 intelligent agent further includes a value determination  
3 module configured to determine a value for a desired  
4 transaction, and wherein the agent negotiation module is  
5 further configured to calculate a range of acceptable  
6 offer prices from the value.

1 22. The apparatus of claim 21, wherein the  
2 intelligent agent operates as a selling agent, and wherein  
3 the agent negotiation module is configured to:

4 (a) select a minimum offer price from the  
5 maximum of (1) a previous asked price and (2) the  
6 value of the desired transaction plus a required  
7 profit margin; and

8 (b) select a maximum offer price from the  
9 minimum of (1) a previous bid price and (2) the value  
10 of the desired transaction plus the required profit  
11 and a negotiating margin.

1 23. The apparatus of claim 21, wherein the  
2 intelligent agent operates as a buying agent, and wherein  
3 the agent negotiation module is configured to:

4 (a) select a minimum offer price from the  
5 maximum of (1) a previous bid price and (2) the value

6 of the desired transaction less a required profit  
7 margin and less a negotiating margin; and

8 (b) select a maximum offer price from the  
9 minimum of (1) a previous asked price and (2) the  
10 value of the desired transaction less the required  
11 profit.

1 24. The apparatus of claim 19, wherein the agent  
2 negotiation module is configured to select a random wait  
3 time between maximum and minimum offer duration times.

1 25. The apparatus of claim 19, wherein the agent  
2 negotiation module is further configured to:

3 (a) complete the transaction if an asked price  
4 from one of the offer and the response is less than  
5 or equal to a bid price from the other of the offer  
6 and the response;

7 (b) determine an accept probability value based  
8 upon the duration of the transaction and the  
9 proximity of the offer and response, the accept  
10 probability value dividing a probability range into  
11 accept and reject portions;

12 (c) select a random number within the  
13 probability range; and

14 (d) complete the transaction if the random  
15 number falls within the accept portion of the  
16 probability range.

1 26. The apparatus of claim 19, wherein the  
2 intelligent agent further comprises a high pass filter

3 that calculates a market slope to detect volatile market  
4 conditions, and adjusts the negotiation strategy upon  
5 detection of volatile market conditions.

1 27. A program product comprising:

2 (a) a program configured to perform a method of  
3 conducting an electronic transaction, the method  
4 comprising the steps of:

5 (1) generating an offer to enter into a  
6 transaction;

7 (2) waiting for a response from a  
8 negotiating party;

9 (3) upon receiving a response, determining  
10 whether to complete the transaction; and

11 (4) disguising a negotiation strategy from  
12 the negotiating party by randomizing a  
13 characteristic of at least one of the  
14 generating, waiting and determining steps; and

15 (b) a signal bearing media bearing the program.

1 28. The program product of claim 27, wherein the  
2 signal bearing media is transmission type media.

1 29. The program product of claim 27, wherein the  
2 signal bearing media is recordable media.

1 30. The program product of claim 27, wherein the  
2 program is an intelligent agent.

1        31. A method of conducting an electronic transaction  
2 with an intelligent agent, the method comprising the steps  
3 of:

4            (a) generating an offer to enter into a  
5 transaction;

6            (b) waiting for a response from a negotiating  
7 party;

8            (c) upon receiving a response, determining  
9 whether to complete the transaction; and

10           (d) limiting unproductive negotiations by  
11 constraining a characteristic of at least one of the  
12 generating, waiting and determining steps based upon  
13 at least one of a behavior of the negotiating party  
14 and a duration of the transaction.

1        32. The method of claim 31, further comprising the  
2 step of disguising a negotiation strategy from the  
3 negotiating party by randomizing a characteristic of at  
4 least one of the generating, waiting and determining  
5 steps.

1        33. The method of claim 31, wherein the offer  
2 generating step includes the step of determining a value  
3 for a desired transaction, and wherein the constraining  
4 step includes the step of calculating a range of  
5 acceptable offer prices from the value.

1        34. The method of claim 33, wherein the value  
2 determining step includes the steps of:

3 (a) retrieving a plurality of related  
4 transactions that are related to the desired  
5 transaction, each related transaction having a value  
6 associated therewith;

7 (b) for each related transaction, weighting the  
8 value of the related transaction based upon a  
9 proximity between the related and desired  
10 transactions to obtain a weighted value; and

11 (c) normalizing the weighted values to generate  
12 the value for the desired transaction therefrom.

1 35. The method of claim 33, wherein the value  
2 determining step includes the steps of:

3 (a) generating a plurality of estimated values  
4 from a plurality of information sources;

5 (b) weighting the plurality of estimated values  
6 based upon a predetermined criteria to generate a  
7 plurality of weighted estimated values; and

8 (c) normalizing the plurality of weighted  
9 estimated values to generate the value for the  
10 desired transaction therefrom.

1 36. The method of claim 33, wherein the agent  
2 operates as a selling agent, and wherein the calculating  
3 the range of acceptable prices step includes the steps of:

4 (a) selecting a minimum offer price from the  
5 maximum of (1) a previous asked price and (2) the  
6 value of the desired transaction plus a required  
7 profit margin; and



8           (b) selecting a maximum offer price from the  
 9           minimum of (1) a previous bid price and (2) the value  
 10          of the desired transaction plus the required profit  
 11          and a negotiating margin.

1          37. The method of claim 33, wherein the agent  
 2          operates as a buying agent, and wherein the calculating  
 3          the range of acceptable prices step includes the steps of:

4           (a) selecting a minimum offer price from the  
 5           maximum of (1) a previous bid price and (2) the value  
 6           of the desired transaction less a required profit  
 7           margin and less a negotiating margin; and

8           (b) selecting a maximum offer price from the  
 9           minimum of (1) a previous asked price and (2) the  
 10          value of the desired transaction less the required  
 11          profit.

1          38. The method of claim 33, wherein the offer  
 2          generating step comprises the step of detecting a real  
 3          price for the negotiating party, and wherein the  
 4          constraining step includes the step of constraining the  
 5          range of acceptable offer prices using the real price.

1          39. The method of claim 31, wherein the constraining  
 2          step includes the step of calculating a wait probability  
 3          value based upon the duration of the transaction and a  
 4          last offer received from the negotiating party.

1          40. The method of claim 39, wherein the constraining  
 2          step further includes the steps of:

3           (a) generating a probability distribution from  
4 the wait probability value; and

5           (b) selecting a random point in the probability  
6 distribution to generate an offer duration for the  
7 waiting step.

1       41. The method of claim 31, wherein the constraining  
2 step further includes the steps of:

3           (a) determining an accept probability value  
4 based upon the duration of the transaction and the  
5 proximity of the offer and response, the accept  
6 probability value dividing a probability range into  
7 accept and reject portions;

8           (b) selecting a random number within the  
9 probability range; and

10          (c) completing the transaction if the random  
11 number falls within the accept portion of the  
12 probability range.

1       42. The method of claim 31, further comprising the  
2 step of determining whether to make a counteroffer,  
3 including the steps of:

4           (a) determining a counteroffer probability  
5 value based upon the duration of the transaction and  
6 the proximity of the offer and response, the  
7 counteroffer probability value dividing a probability  
8 range into counteroffer and no counteroffer portions;

9           (b) selecting a random number within the  
10 probability range; and

11 (c) making a counteroffer if the random number  
12 falls within the counteroffer portion of the  
13 probability range.

1 43. An apparatus for conducting an electronic  
2 transaction, the apparatus including an intelligent agent  
3 computer program executed by the apparatus, the  
4 intelligent agent including an agent negotiation module  
5 configured to perform the method steps of:

6 (a) generating an offer to enter into a  
7 transaction;

8 (b) waiting for a response from a negotiating  
9 party;

10 (c) upon receiving a response, determining  
11 whether to complete the transaction; and

12 (d) limiting unproductive negotiations by  
13 constraining a characteristic of at least one of the  
14 generating, waiting and determining steps based upon  
15 at least one of a behavior of the negotiating party  
16 and a duration of the transaction.

1 44. The apparatus of claim 43, wherein the agent  
2 negotiation module is further configured to disguise a  
3 negotiation strategy from the negotiating party by  
4 randomizing a characteristic of at least one of the  
5 generating, waiting and determining steps.

1 45. The apparatus of claim 43, wherein the  
2 intelligent agent further includes a value determination  
3 module configured to determine a value for a desired

4 transaction, and wherein the agent negotiation module is  
5 further configured to calculate a range of acceptable  
6 offer prices from the value.

1 46. The apparatus of claim 45, wherein the  
2 intelligent agent operates as a selling agent, and wherein  
3 the agent negotiation module is configured to:

4 (a) select a minimum offer price from the  
5 maximum of (1) a previous asked price and (2) the  
6 value of the desired transaction plus a required  
7 profit margin; and

8 (b) select a maximum offer price from the  
9 minimum of (1) a previous bid price and (2) the value  
10 of the desired transaction plus the required profit  
11 and a negotiating margin.

1 47. The apparatus of claim 45, wherein the  
2 intelligent agent operates as a buying agent, and wherein  
3 the agent negotiation module is configured to:

4 (a) select a minimum offer price from the  
5 maximum of (1) a previous bid price and (2) the value  
6 of the desired transaction less a required profit  
7 margin and less a negotiating margin; and

8 (b) select a maximum offer price from the  
9 minimum of (1) a previous asked price and (2) the  
10 value of the desired transaction less the required  
11 profit.

1 48. The apparatus of claim 43, wherein the agent  
2 negotiation module is further configured to:

3 (a) determine an accept probability value based  
4 upon the duration of the transaction and the  
5 proximity of the offer and response, the accept  
6 probability value dividing a probability range into  
7 accept and reject portions;

8 (b) select a random number within the  
9 probability range; and

10 (c) complete the transaction if the random  
11 number falls within the accept portion of the  
12 probability range.

1 49. The apparatus of claim 43, wherein the agent  
2 negotiation module is further configured to:

3 (a) determine a counteroffer probability value  
4 based upon the duration of the transaction and the  
5 proximity of the offer and response, the counteroffer  
6 probability value dividing a probability range into  
7 counteroffer and no counteroffer portions;

8 (b) select a random number within the  
9 probability range; and

10 (c) make a counteroffer if the random number  
11 falls within the counteroffer portion of the  
12 probability range.

1 50. A program product comprising:

2 (a) a program configured to perform a method of  
3 conducting an electronic transaction, the method  
4 comprising the steps of:

5 (1) generating an offer to enter into a  
6 transaction;

7 (2) waiting for a response from a  
8 negotiating party;

9 (3) upon receiving a response, determining  
10 whether to complete the transaction; and

11 (4) limiting unproductive negotiations by  
12 constraining a characteristic of at least one of  
13 the generating, waiting and determining steps  
14 based upon at least one of a behavior of the  
15 negotiating party and a duration of the  
16 transaction; and

17 (b) a signal bearing media bearing the program.

1 51. The program product of claim 50, wherein the  
2 signal bearing media is transmission type media.

1 52. The program product of claim 50, wherein the  
2 signal bearing media is recordable media.

1 53. The program product of claim 50, wherein the  
2 program is an intelligent agent.

1 54. A method of identifying an unknown party.  
2 interacting with an intelligent agent, the method  
3 comprising the steps of:

4 (a) determining at least one attribute related  
5 to the unknown party;

6 (b) comparing the attribute for the unknown  
7 party with attributes related to a plurality of known  
8 parties; and



9 (c) identifying the unknown party as the known  
10 party having the attribute which most closely matches  
11 that of the unknown party.

1 55. The method of claim 54, wherein the determining  
2 step determines a plurality of attributes related to the  
3 unknown party, and wherein the comparing step compares the  
4 plurality of attributes for the unknown party with those  
5 of the plurality of known parties.

1 56. The method of claim 55, wherein the comparing  
2 step includes the step of accessing a database including a  
3 plurality of records, each record associated with a known  
4 party and including the plurality of attributes related  
5 thereto.

1 57. The method of claim 55, wherein each of the  
2 plurality of attributes has a weighting factor associated  
3 therewith, wherein the comparing step calculates an  
4 accumulated weighting factor for each known party by  
5 summing the weighting factors of the attributes of the  
6 known party which match those of the unknown party, and  
7 wherein the identifying step identifies the unknown party  
8 as the known party with the largest accumulated weighting  
9 factor.

1 58. The method of claim 55, wherein the unknown  
2 party is an intelligent agent configured to conduct  
3 electronic transactions, and wherein the plurality of  
4 attributes is selected from the group consisting of an

5 agent name, a client name, a bank name, a bank account  
 6 number, a credit card number, a homebase location, an  
 7 agent program name, a location or name of a source with  
 8 which the unknown party communicates, and combinations  
 9 thereof.

1 59. The method of claim 55, wherein the unknown  
 2 party is an intelligent agent, and wherein the determining  
 3 step includes the step of scanning program code for the  
 4 unknown party to determine attributes thereof.

1 60. An apparatus for identifying an unknown party  
 2 interacting with an intelligent agent, comprising:

3 (a) a database including a plurality of  
 4 records, each record associated with a known party  
 5 and including the plurality of attributes related  
 6 thereto; and

7 (b) an identification module, coupled to the  
 8 database, the identification module configured to  
 9 compare a plurality of attributes for the unknown  
 10 party with those of each known party and to identify  
 11 the unknown party as the known party having the  
 12 attributes which most closely match those of the  
 13 unknown party.

1 61. A program product comprising:

2 (a) a program configured to perform a method of  
 3 identifying an unknown party interacting with an  
 4 intelligent agent, the method comprising the steps  
 5 of:

- 6 (1) determining at least one attribute  
7 related to the unknown party;  
8 (2) comparing the attribute for the  
9 unknown party with attributes related to a  
10 plurality of known parties; and  
11 (3) identifying the unknown party as the  
12 known party having the attribute which most  
13 closely matches that of the unknown party; and  
14 (b) a signal bearing media bearing the program.

1 62. The program product of claim 61, wherein the  
2 signal bearing media is transmission type media.

1 63. The program product of claim 61, wherein the  
2 signal bearing media is recordable media.

1 64. A method of dynamically determining a value for  
2 a desired transaction, comprising the steps of:  
3 (a) generating a plurality of estimated values  
4 from a plurality of information sources;  
5 (b) weighting the plurality of estimated values  
6 based upon a predetermined criteria to generate a  
7 plurality of weighted estimated values; and  
8 (c) normalizing the plurality of weighted  
9 estimated values to generate the value for the  
10 desired transaction therefrom.

1 65. The method of claim 64, wherein the  
2 predetermined criteria is determined empirically.

1        66. The method of claim 64, wherein the plurality of  
2 information sources includes a database of related  
3 transactions, each related transaction having a value  
4 associated therewith, and wherein the generating step  
5 includes the steps of:

6            (a) retrieving a plurality of related  
7 transactions from the database;

8            (b) for each related transaction retrieved from  
9 the database, weighting the value of the related  
10 transaction based upon a proximity between the  
11 related and desired transactions to obtain a weighted  
12 value; and

13           (c) normalizing the weighted values to generate  
14 the estimated value for the database information  
15 source.

1        67. The method of claim 66, wherein the database is  
2 selected from the group consisting of a history database  
3 including a plurality of past transactions and a current  
4 market status database including a plurality of current  
5 transactions.

1        68. The method of claim 66, wherein the plurality of  
2 information sources includes a second database of related  
3 transactions, wherein the first database is a history  
4 database including a plurality of past transactions and  
5 the second database is a current market status database  
6 including a plurality of current transactions.

1        69. The method of claim 64, wherein the plurality of  
2 information sources includes a base and delta values  
3 database, and wherein the generating step includes the  
4 steps of retrieving base and delta values related to the  
5 desired transaction from the base and delta values  
6 database and summing the base and delta values to obtain  
7 the value estimate for the base and delta values database  
8 information source.

1        70. The method of claim 64, wherein the plurality of  
2 information sources includes a rules database, and wherein  
3 the generating step includes the steps of retrieving rules  
4 from the rules database and processing the retrieved rules  
5 with an expert system to generate the value estimate for  
6 the rules database information source.

1        71. The method of claim 64, wherein the  
2 predetermined criteria includes a reliability of each  
3 estimated value.

1        72. An apparatus that dynamically determines a value  
2 for a desired transaction, the apparatus comprising:  
3            (a) a plurality of information sources;  
4            (b) a plurality of value estimators, each value  
5 estimator coupled to at least one of the plurality of  
6 information sources and configured to generate an  
7 estimated value;  
8            (c) a plurality of weighting blocks, each  
9 weighting block coupled to at least one of the value  
10 estimators and configured to weight at least one of

11 the estimated values based upon a predetermined  
12 criteria and generate a weighted estimated value  
13 therefrom; and

14 (d) a normalizing block, coupled to the  
15 plurality of weighting blocks and configured to  
16 normalize the weighted estimated values and generate  
17 the value for the desired transaction therefrom.

1 73. The apparatus of claim 72, wherein the plurality  
2 of information sources includes a database of related  
3 transactions, each related transaction having a value  
4 associated therewith, and wherein the value estimator  
5 coupled to the database includes:

6 (a) at least one weighting block, coupled to  
7 the database, the weighting block configured to  
8 output a weighted value for each related transaction,  
9 the weighted value for each related transaction  
10 related to a proximity between the related  
11 transaction and the desired transaction; and

12 (b) a normalizing block, coupled to the  
13 weighting block, the normalizing block configured to  
14 normalize each weighted value and generate therefrom  
15 the estimated value for the database information  
16 source.

1 74. The apparatus of claim 73, wherein the database  
2 is selected from the group consisting of a history  
3 database including a plurality of past transactions and a  
4 current market status database including a plurality of  
5 current transactions.



1        75. The apparatus of claim 73, wherein the plurality  
2 of information sources includes a second database of  
3 related transactions, wherein the first database is a  
4 history database including a plurality of past  
5 transactions and the second database is a current market  
6 status database including a plurality of current  
7 transactions.

1        76. The apparatus of claim 72, wherein the plurality  
2 of information sources includes a database of base and  
3 delta values, and wherein the value estimator coupled to  
4 the database is configured to retrieve base and delta  
5 values related to the desired transaction from the  
6 database and sum the base and delta values to obtain the  
7 value estimate therefor.

1        77. The apparatus of claim 76, wherein the plurality  
2 of information sources further includes a rules database,  
3 and wherein the value estimator coupled to the rules  
4 database includes an expert system configured to retrieve  
5 rules from the rules database and output the value  
6 estimate therefrom.

1        78. A program product comprising:

2            (a) a program configured to perform a method of  
3 dynamically determining a value for a desired  
4 transaction, the method comprising the steps of:

5                    (1) generating a plurality of estimated  
6 values from a plurality of information sources;

- 7           (2) weighting the plurality of estimated  
8 values based upon a predetermined criteria to  
9 generate a plurality of weighted estimated  
10 values; and
- 11           (3) normalizing the plurality of weighted  
12 estimated values to generate the value for the  
13 desired transaction therefrom; and
- 14           (b) a signal bearing media bearing the program.

1           79. The program product of claim 78, wherein the  
2 signal bearing media is transmission type media.

1           80. The program product of claim 78, wherein the  
2 signal bearing media is recordable media.

1           81. A method of dynamically determining a value for  
2 a desired transaction, comprising the steps of:

3           (a) retrieving a plurality of related  
4 transactions, each related transaction having a value  
5 associated therewith;

6           (b) for each related transaction, weighting the  
7 value of the related transaction based upon a  
8 proximity between the related and desired  
9 transactions to obtain a weighted value; and

10           (c) normalizing the weighted values to generate  
11 the value for the desired transaction therefrom.

1           82. The method of claim 81, wherein the related  
2 transactions include past transactions.

1        83. The method of claim 81, wherein the related  
2 transactions include current transactions.

1        84. The method of claim 81, further comprising the  
2 step of, for each related transaction, standardizing the  
3 value of each related transaction based upon the proximity  
4 between the related and desired transactions.

1        85. The method of claim 84, wherein the  
2 standardizing step includes the step of determining the  
3 proximity of the related and desired transactions based  
4 upon a similarity of at least one predetermined  
5 characteristic for the related and desired transactions,  
6 the predetermined characteristic selected from the group  
7 consisting of time, description, and quantity.

1        86. The method of claim 84, wherein the  
2 standardizing step includes the step of temporally  
3 extrapolating the value of each related transaction.

1        87. The method of claim 81, wherein the weighting  
2 step includes the step of determining the proximity of the  
3 related and desired transactions based upon a similarity  
4 of at least one of description and time for the related  
5 and desired transactions.

1        88. The method of claim 81, further comprising the  
2 step of, for each related transaction, weighting the value  
3 of the related transaction based upon at least one of  
4 reliability and quantity.

1        89. The method of claim 88, further comprising the  
2 step of determining the reliability of a related  
3 transaction by identifying a party for the related  
4 transaction.

1        90. The method of claim 89, wherein the determining  
2 the reliability step includes the step of comparing at  
3 least one attribute for the party with attributes for a  
4 plurality of known parties to match the party with one of  
5 the plurality of known parties.

1        91. The method of claim 81, wherein the related  
2 transactions include buy and sell offers, wherein the  
3 weighting step includes the step of separately weighting  
4 the buy offers and sell offers to obtain weighted buy  
5 offers and weighted sell offers, wherein the normalizing  
6 step includes the steps of separately normalizing the  
7 weighted buy offers and the weighted sell offers to  
8 generate a estimated value range; and selecting the  
9 estimated value within the estimated value range.

1        92. The method of claim 81, wherein the retrieving  
2 step includes the step of filtering out related  
3 transactions selected from the group consisting of low  
4 volume transactions, outlying transactions, open offers,  
5 transactions involving unreliable parties, and  
6 transactions involving a party currently being negotiating  
7 with.

1        93. An apparatus that dynamically determines a value  
2 for a desired transaction, the apparatus comprising:

3            (a) a database of related transactions and  
4 values associated therewith;

5            (b) at least one weighting block, coupled to  
6 the database, the weighting block configured to  
7 output a weighted value for each related transaction,  
8 the weighted value for each related transaction  
9 related to a proximity between the related  
10 transaction and the desired transaction; and

11           (c) a normalizing block, coupled to the  
12 weighting block, the normalizing block configured to  
13 normalize each weighted value and generate therefrom  
14 the value of the desired transaction.

1        94. The apparatus of claim 93, wherein the database  
2 is selected from the group consisting of a history  
3 database including a plurality of past transactions and a  
4 current market status database including a plurality of  
5 current transactions.

1        95. The apparatus of claim 93, further comprising a  
2 value estimator, coupled between the database and the  
3 weighting block, the value estimator configured to  
4 standardize the value of each related transaction based  
5 upon the proximity between the related and desired  
6 transactions.

1        96. The apparatus of claim 95, wherein the value  
2 estimator is configured to determine the proximity of the

3 related and desired transactions based upon a similarity  
4 of at least one predetermined characteristic for the  
5 related and desired transactions, the predetermined  
6 characteristic selected from the group consisting of time,  
7 description, and quantity.

1 97. The apparatus of claim 95, wherein the value  
2 estimator includes an extrapolation block for temporally  
3 extrapolating the value of each related transaction.

1 98. The apparatus of claim 93, wherein the weighting  
2 block is configured to weight each related transaction  
3 based upon a similarity of at least one of description and  
4 time for the related and desired transactions.

1 99. The apparatus of claim 93, further comprising an  
2 additional weighting block configured to weight the value  
3 of each related transaction based upon at least one of  
4 reliability and quantity.

1 100. The apparatus of claim 93, further comprising a  
2 filter, coupled between the database and the weighting  
3 block, the filter configured to filter out related  
4 transactions selected from the group consisting of low  
5 volume transactions, outlying transactions, open offers,  
6 transactions involving unreliable parties, and  
7 transactions involving a party currently being negotiating  
8 with.

1 101. A program product comprising:



2 (a) a program configured to perform a method of  
3 dynamically determining a value for a desired  
4 transaction, the method comprising the steps of:

5 (1) retrieving a plurality of related  
6 transactions, each related transaction having a  
7 value associated therewith;

8 (2) for each related transaction,  
9 weighting the value of the related transaction  
10 based upon a proximity between the related and  
11 desired transactions to obtain a weighted value;  
12 and

13 (3) normalizing the weighted values to  
14 generate the value for the desired transaction  
15 therefrom; and

16 (b) a signal bearing media bearing the program.

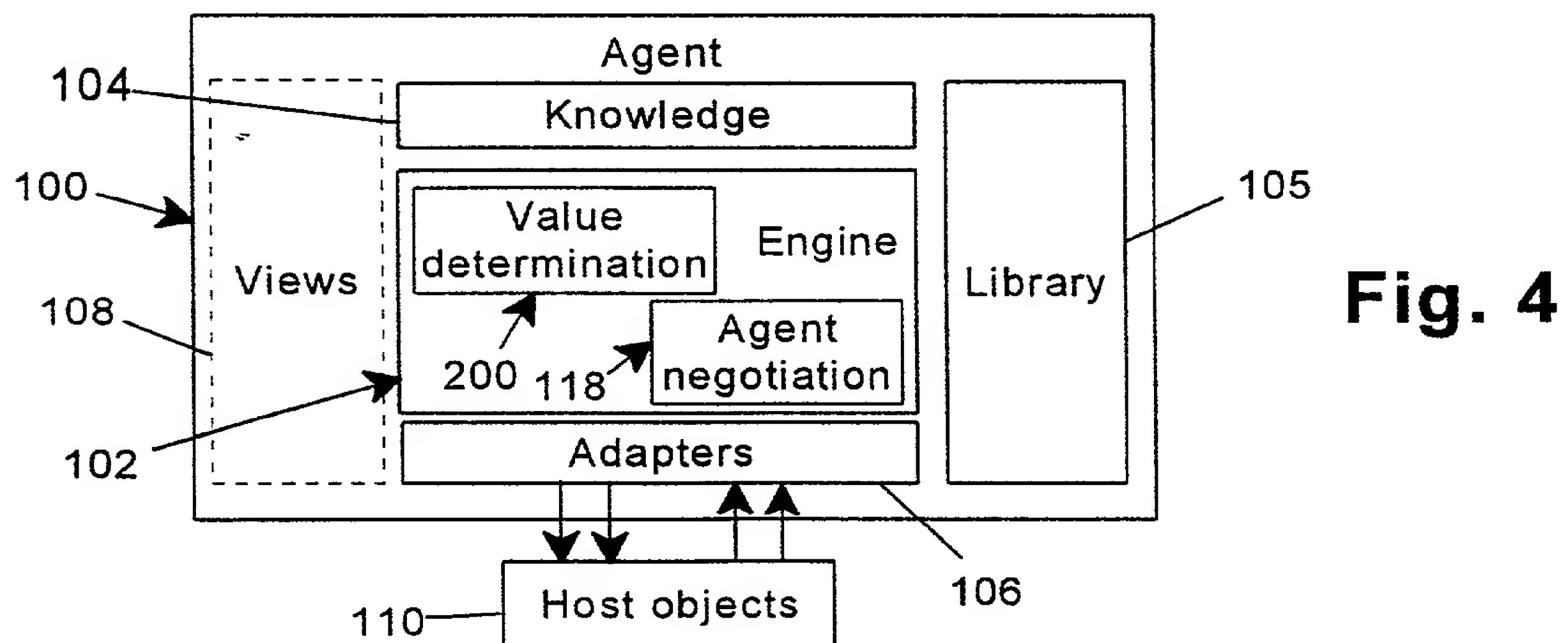
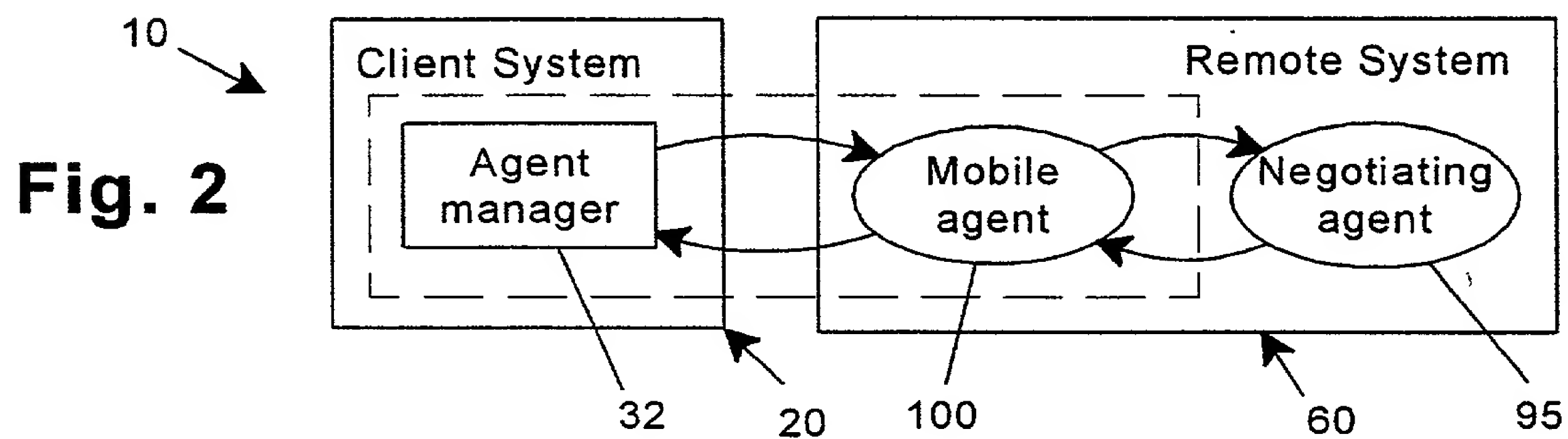
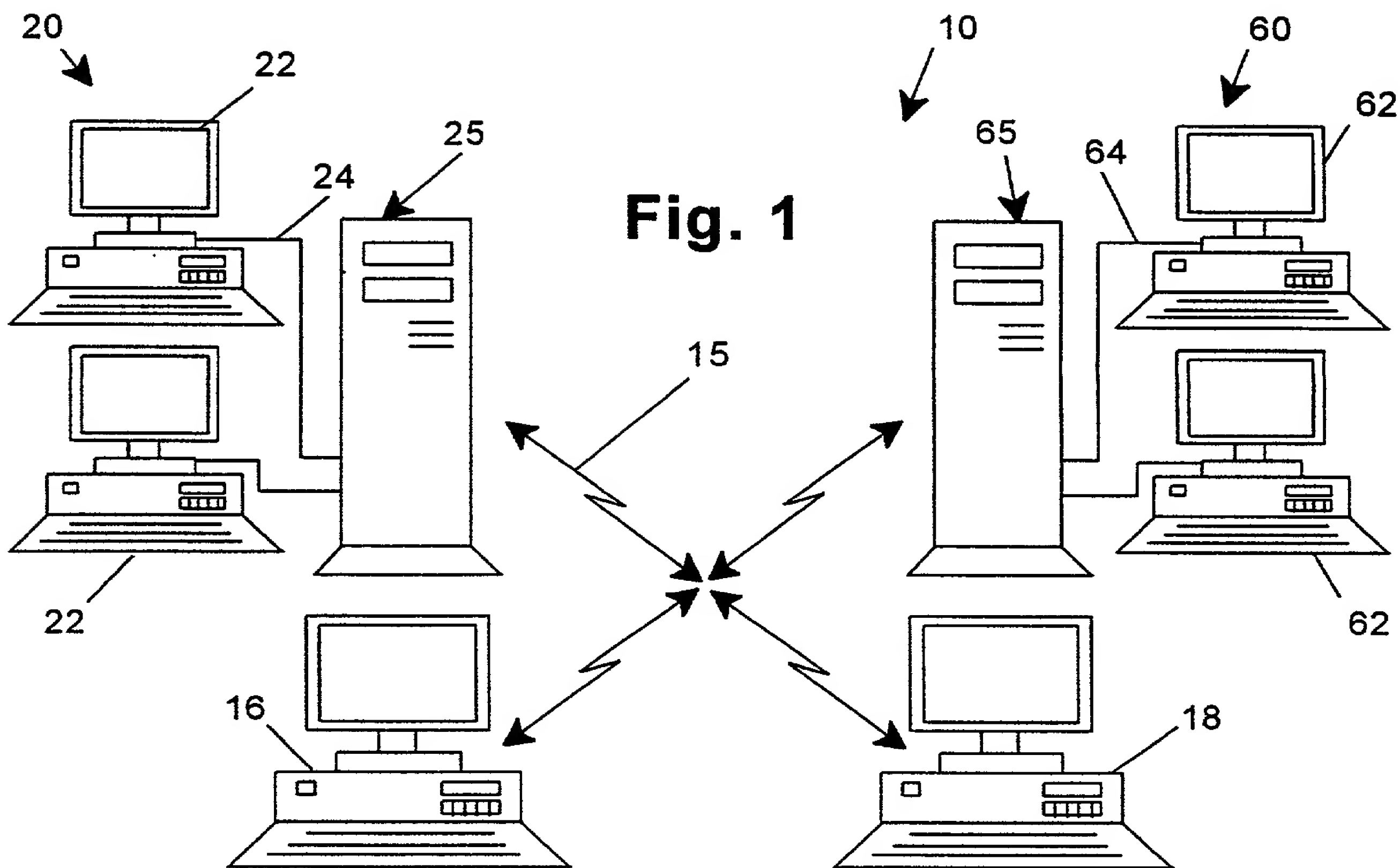
1 102. The program product of claim 101, wherein the  
2 signal bearing media is transmission type media.

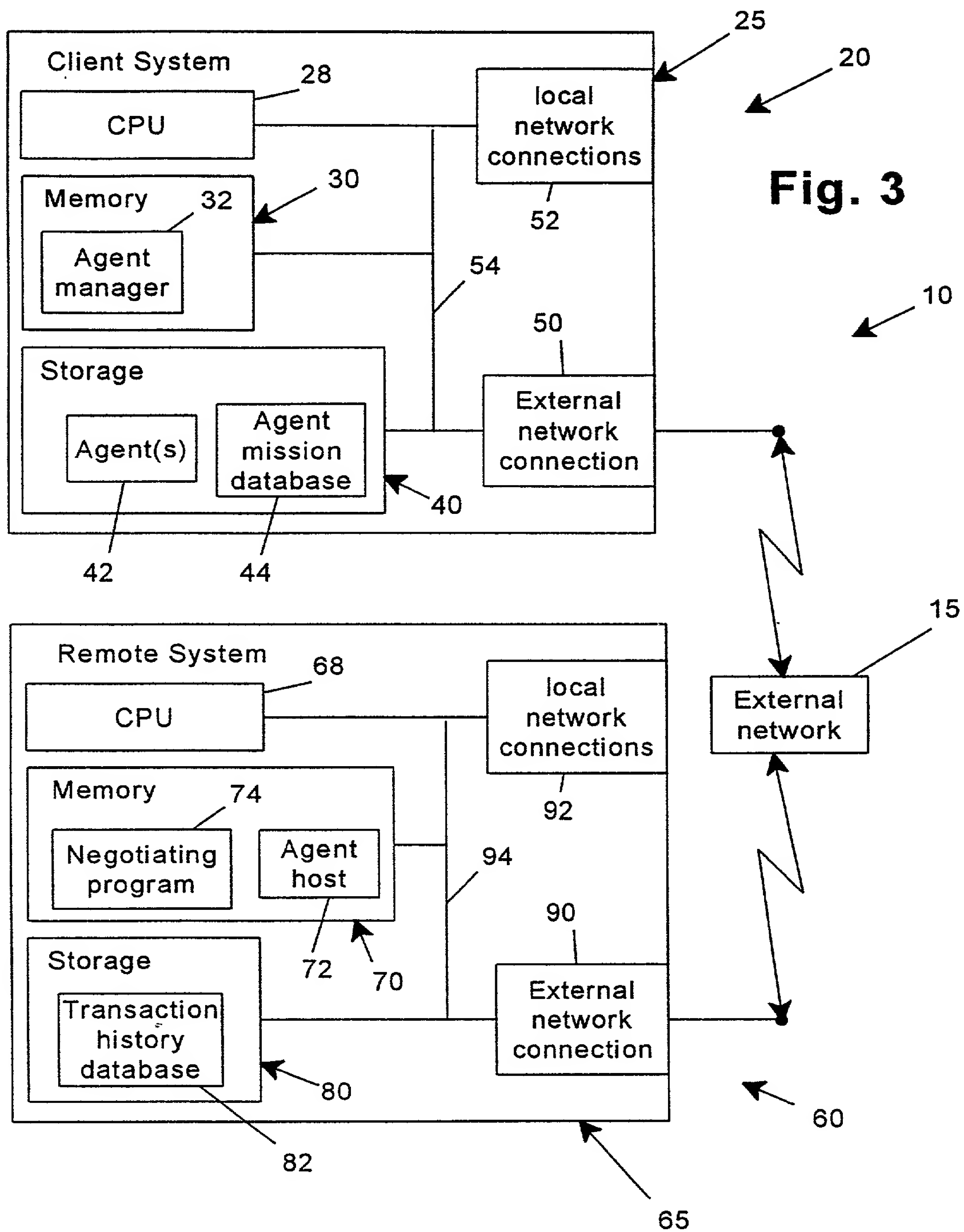
1 103. The program product of claim 101, wherein the  
2 signal bearing media is recordable media.

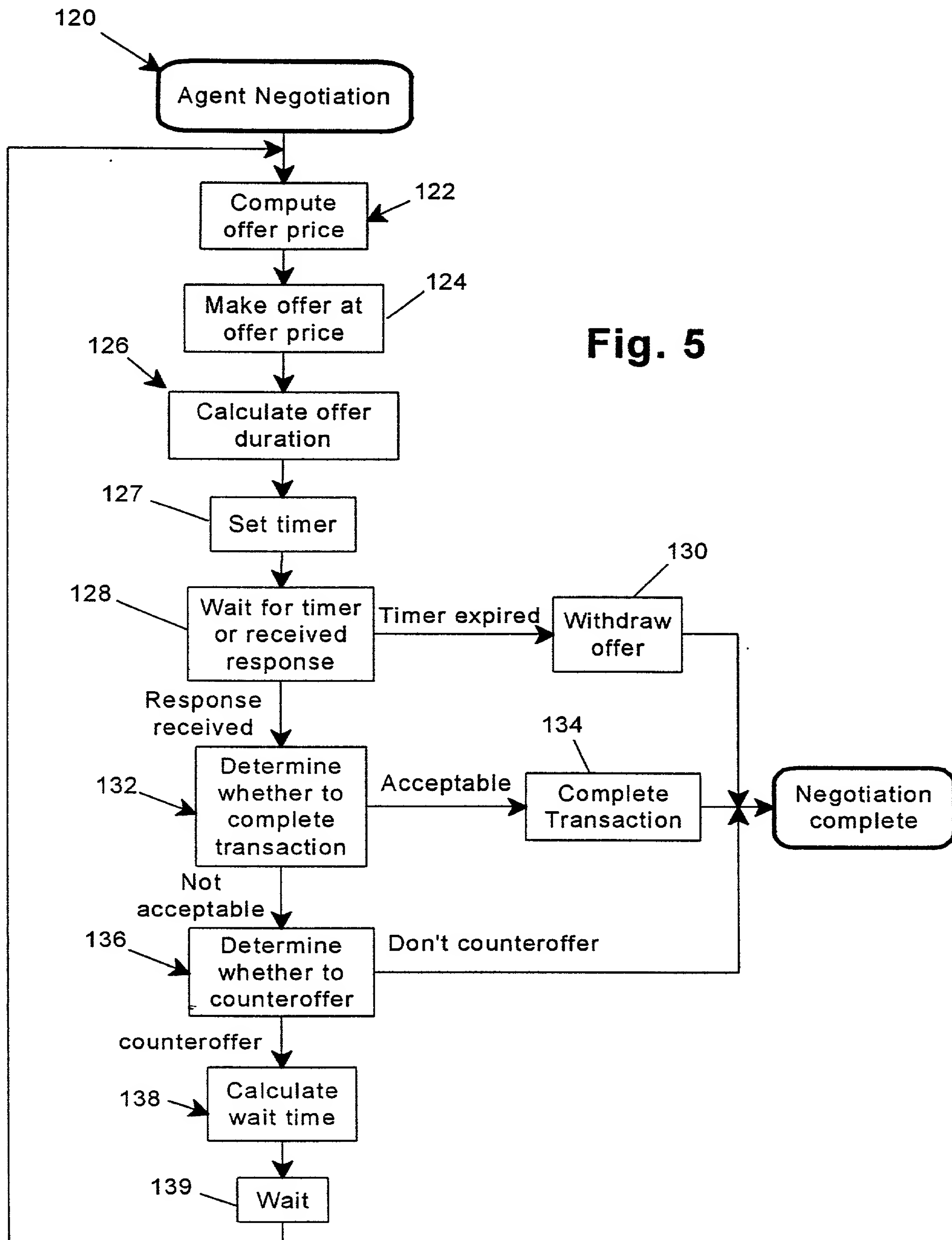
INTELLIGENT AGENT WITH NEGOTIATION CAPABILITY AND METHOD  
OF NEGOTIATION THEREWITH

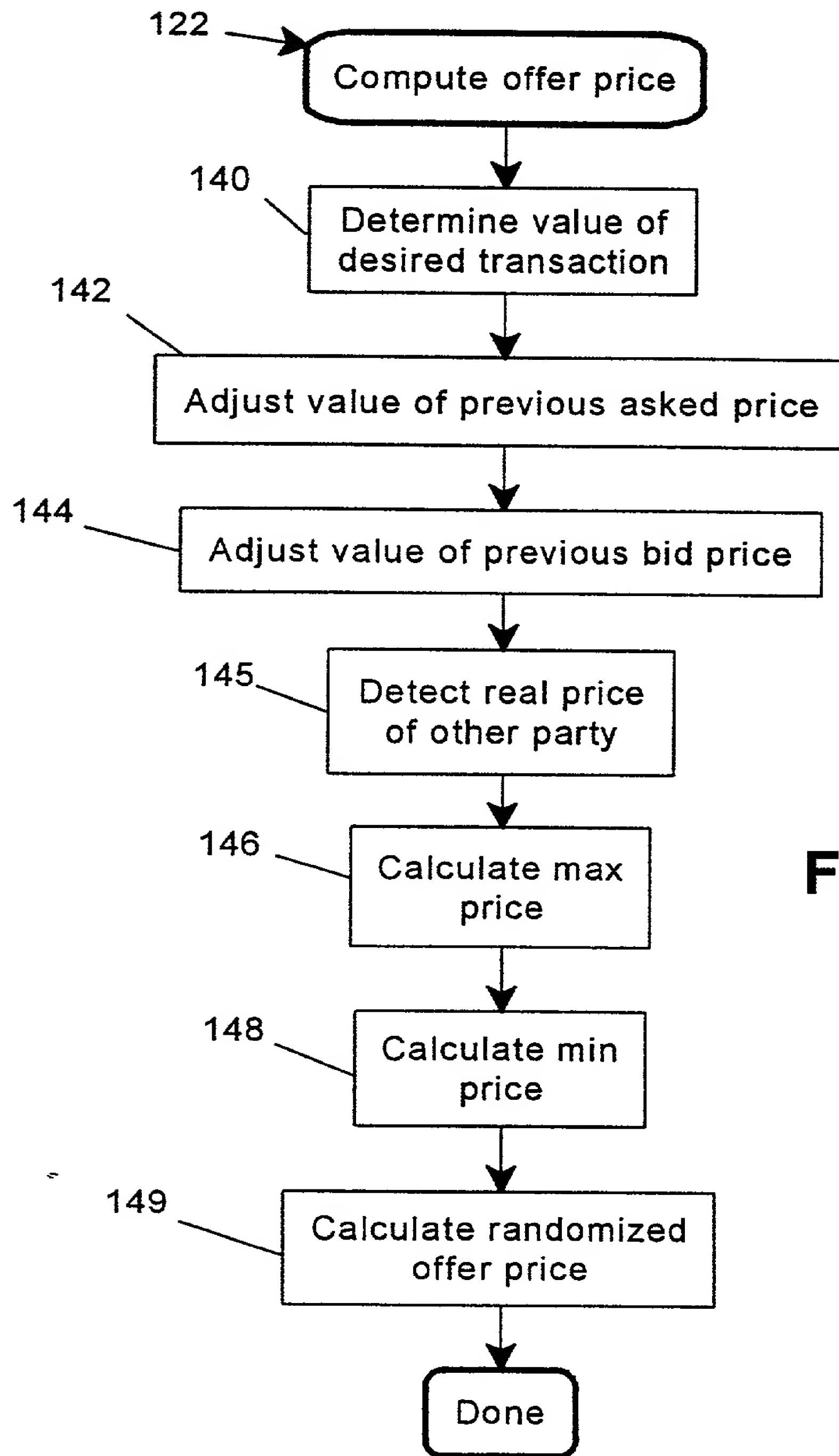
Abstract of the Disclosure

5       An intelligent agent and method of negotiating  
therewith incorporate a number of features, used alone or  
in combination, to enhance the productivity, security,  
efficiency and responsiveness of the agent in negotiations  
with other parties. One feature incorporates  
10 randomization of one or more aspects of an agent's  
behavior to disguise its negotiation strategy from other  
negotiating parties and thereby prevent such parties from  
gaining a negotiating advantage at the expense of the  
agent. Another features incorporates limiting  
15 unproductive negotiations by constraining one or more  
aspects of an agent's behavior based upon the behavior of  
a negotiating party and/or the duration of the  
transaction, and thereby making it more likely that  
unproductive negotiations will be terminated. An  
20 additional feature incorporates dynamic value  
determination to determine the desired value of a desired  
transaction by weighting and normalizing estimated values  
retrieved from a plurality of information sources.  
Moreover, a further features incorporates dynamic value  
25 determination which weights and normalizes the values of  
related transactions based upon the proximity of the  
related and desired transactions.









**Fig. 6**



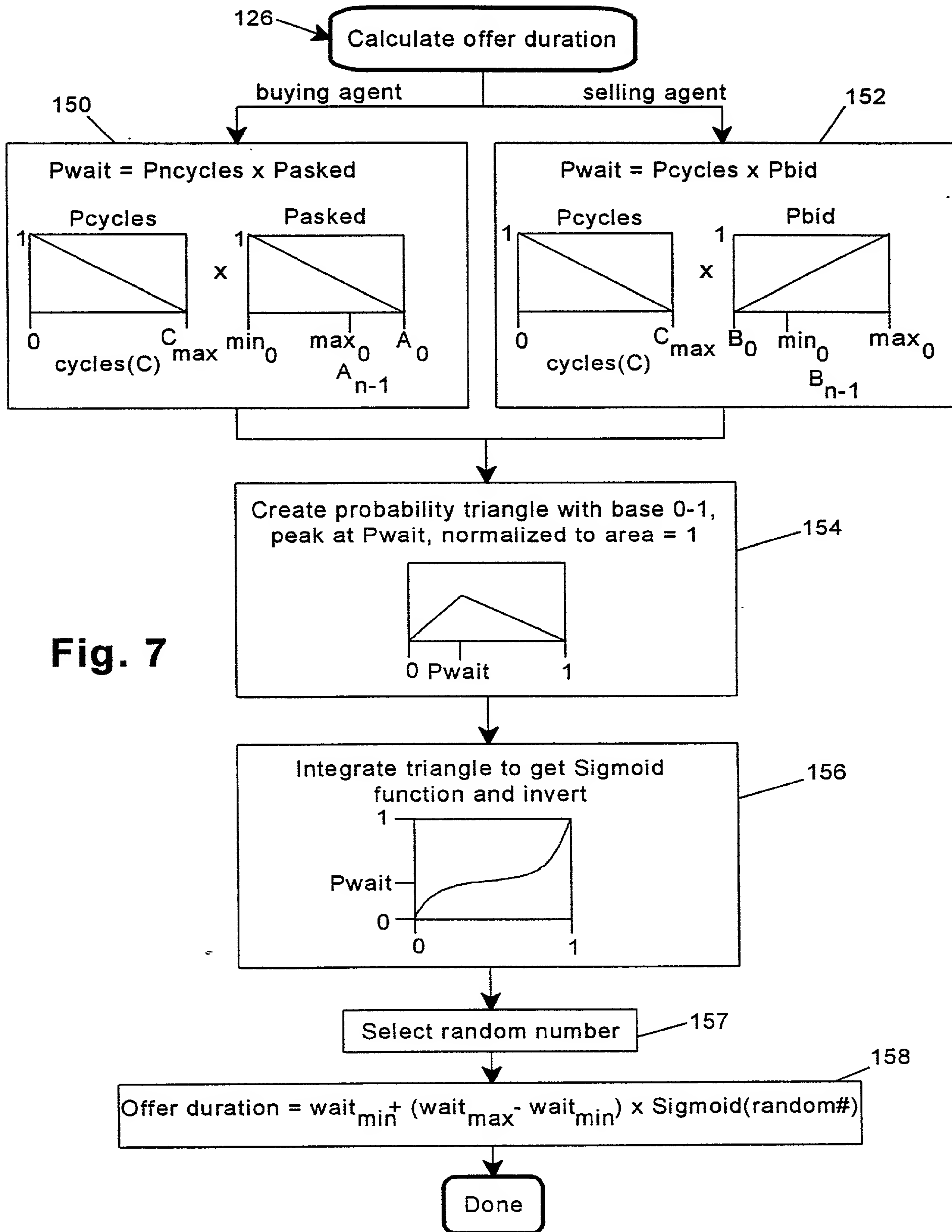


Fig. 7

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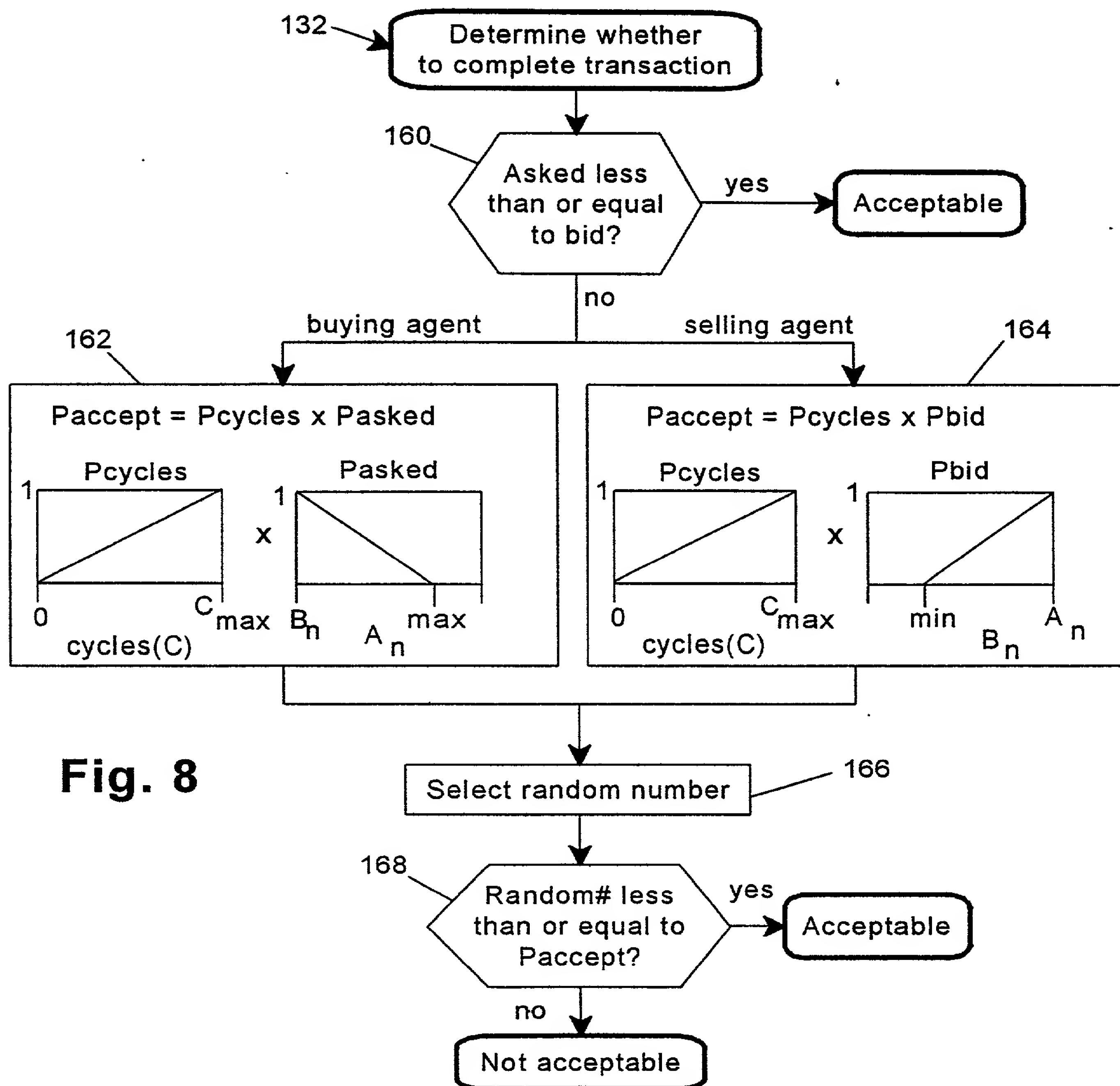


Fig. 9

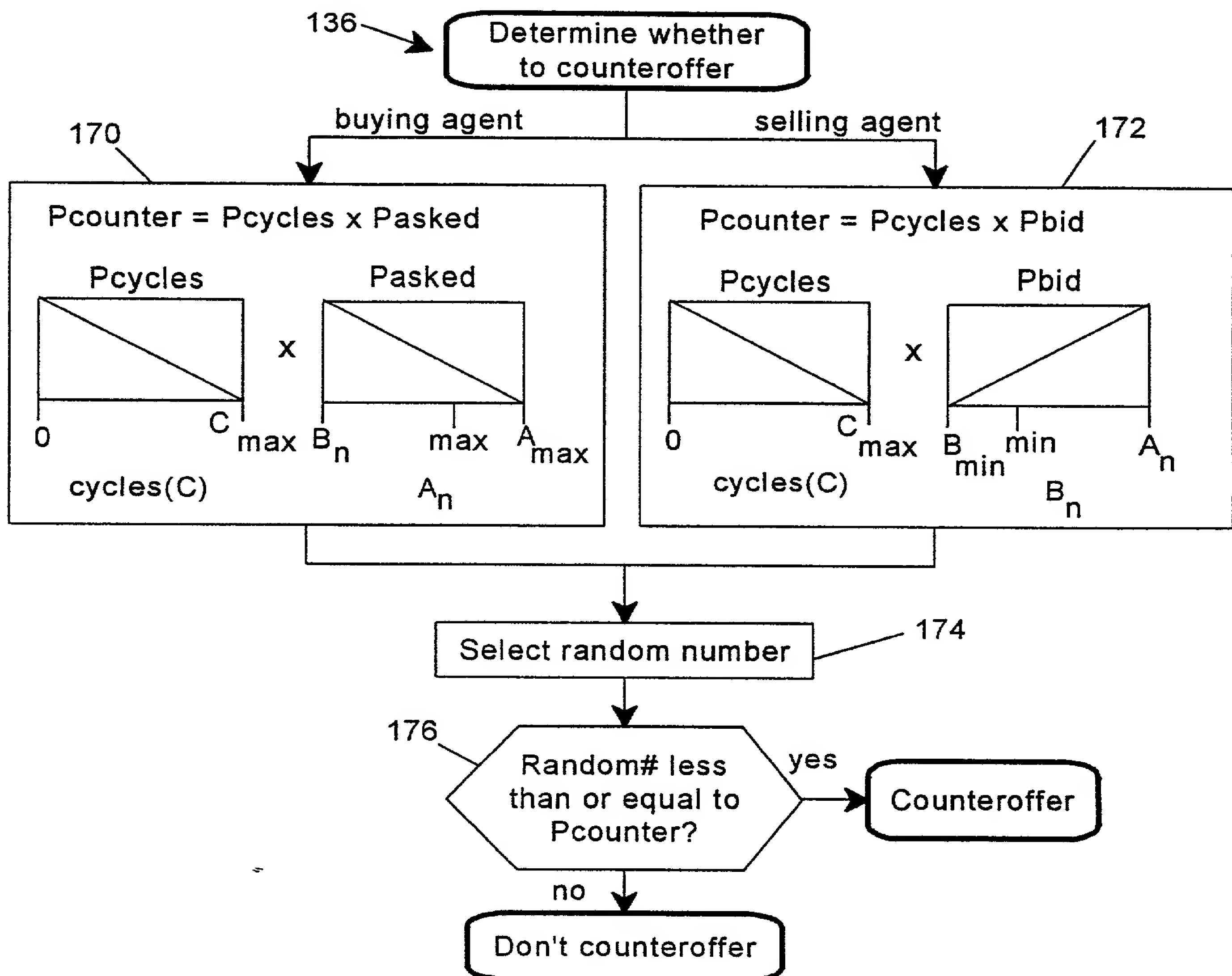
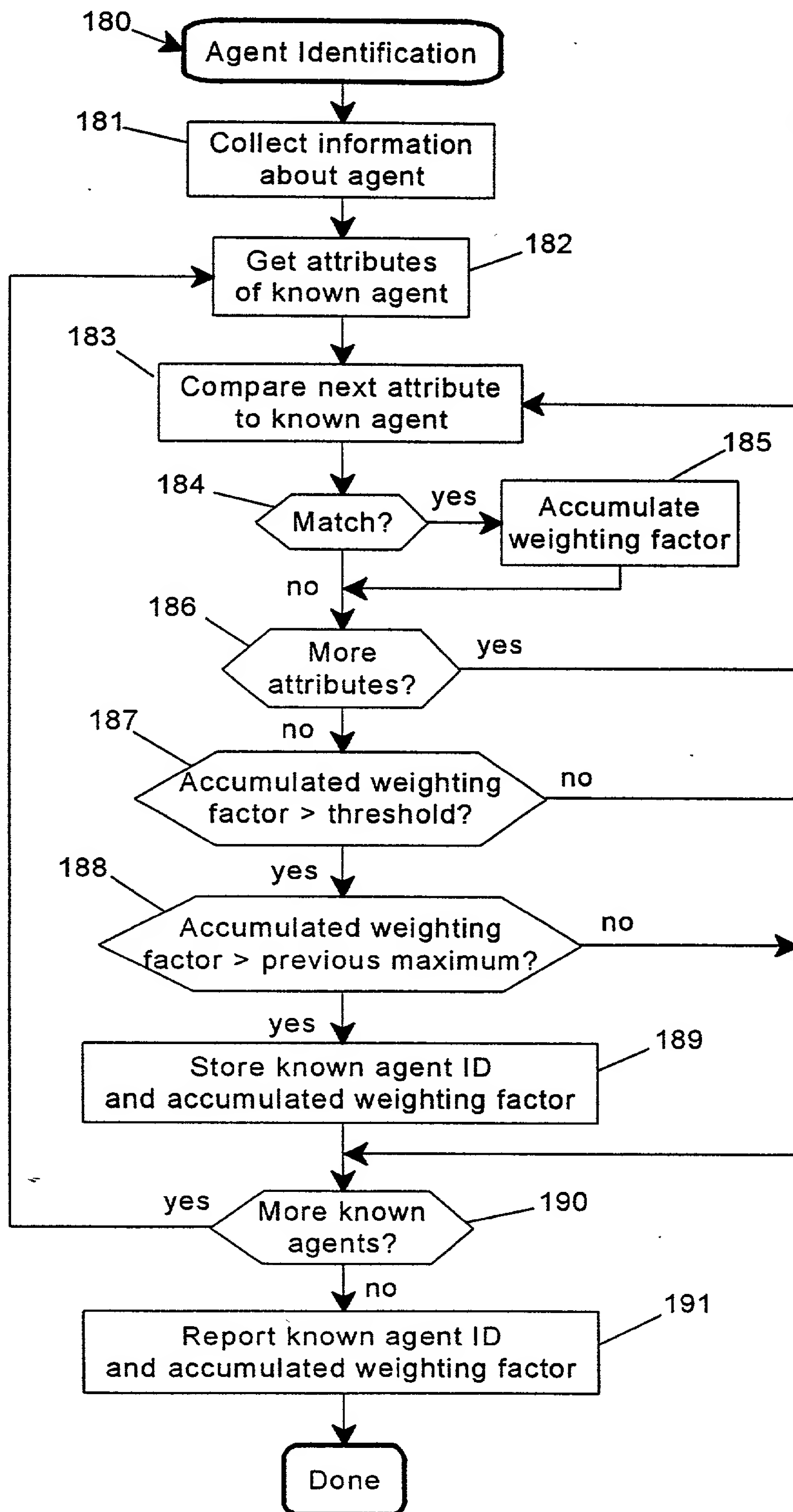
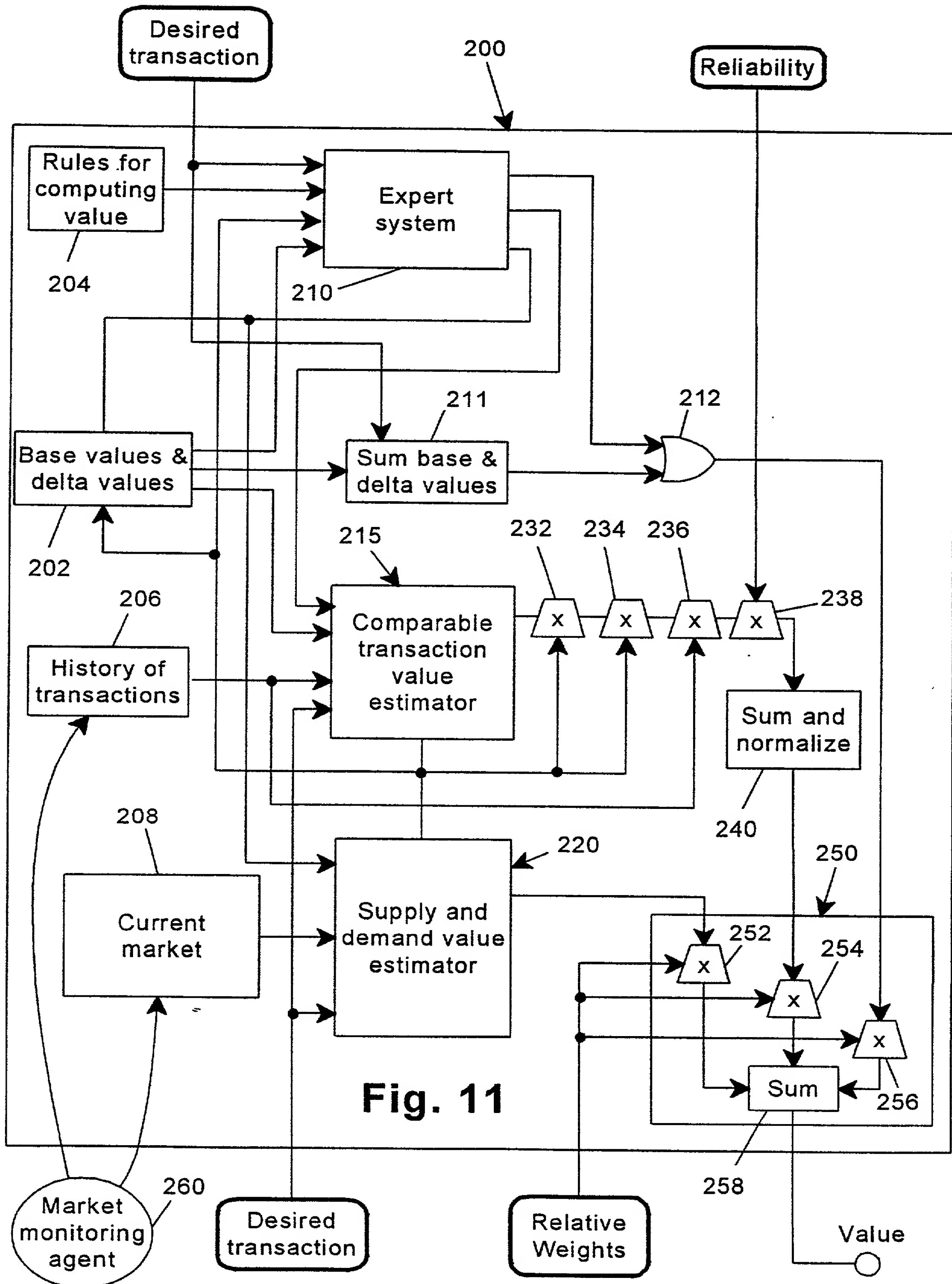


Fig. 10





**Fig. 11**

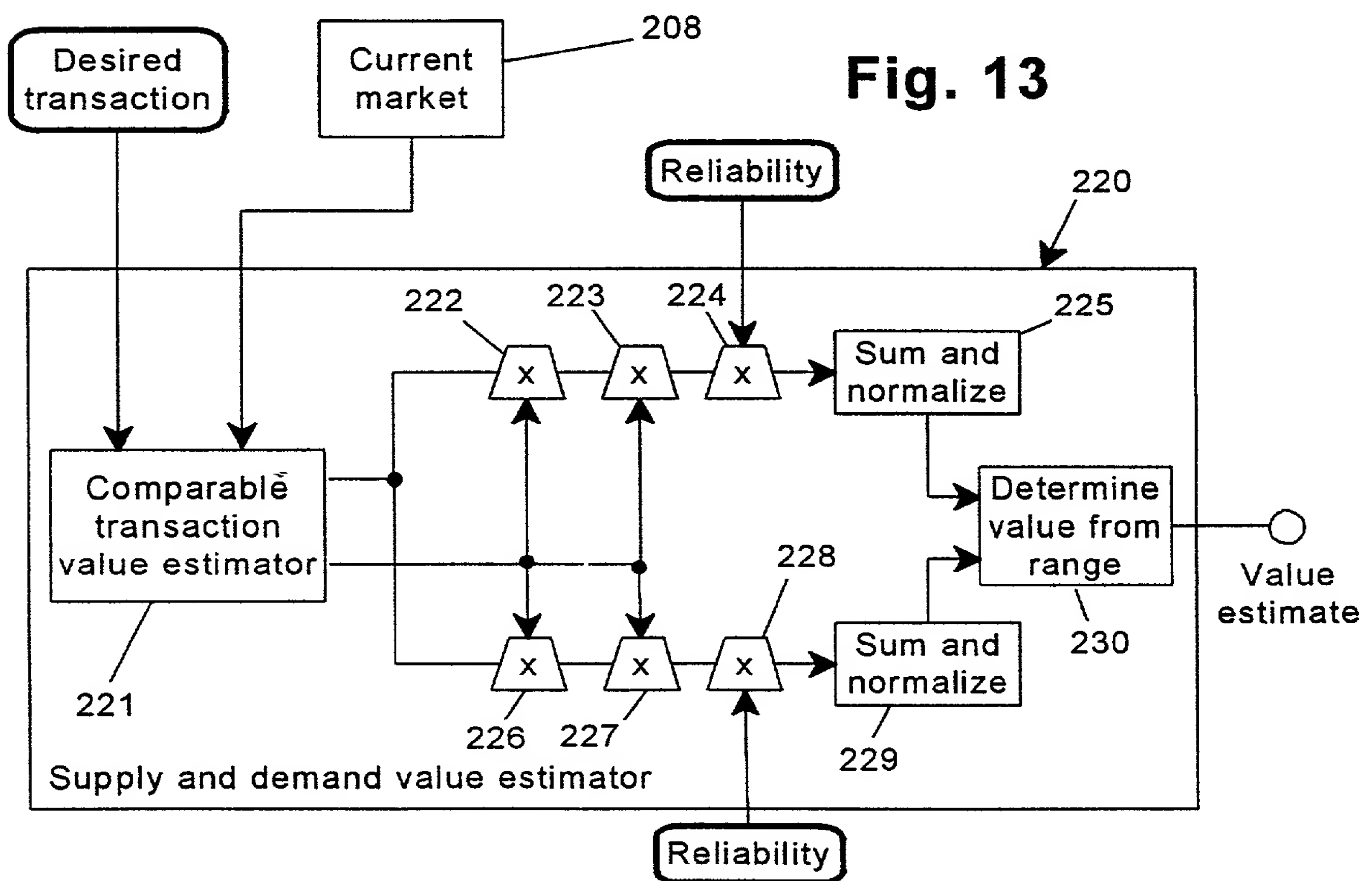
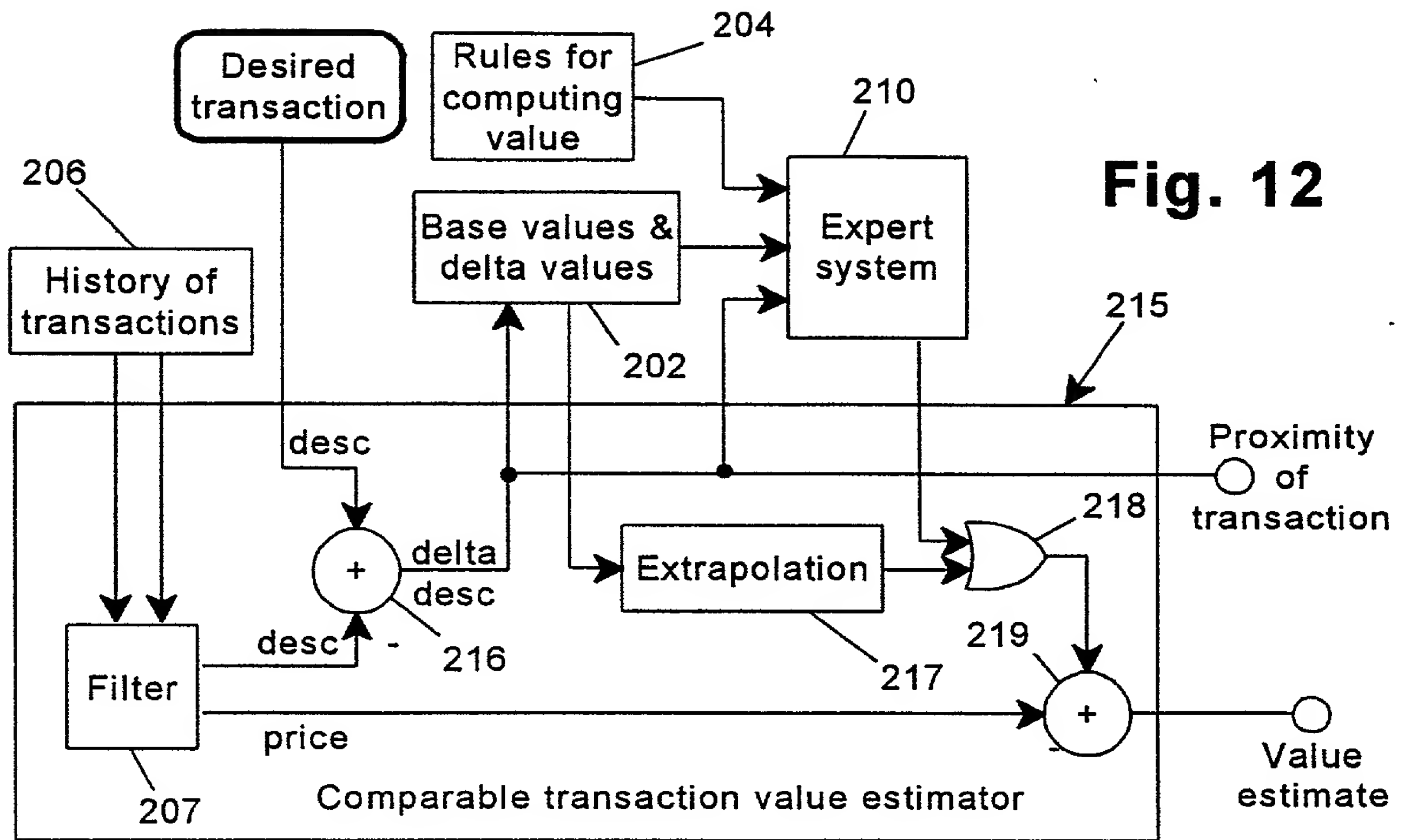
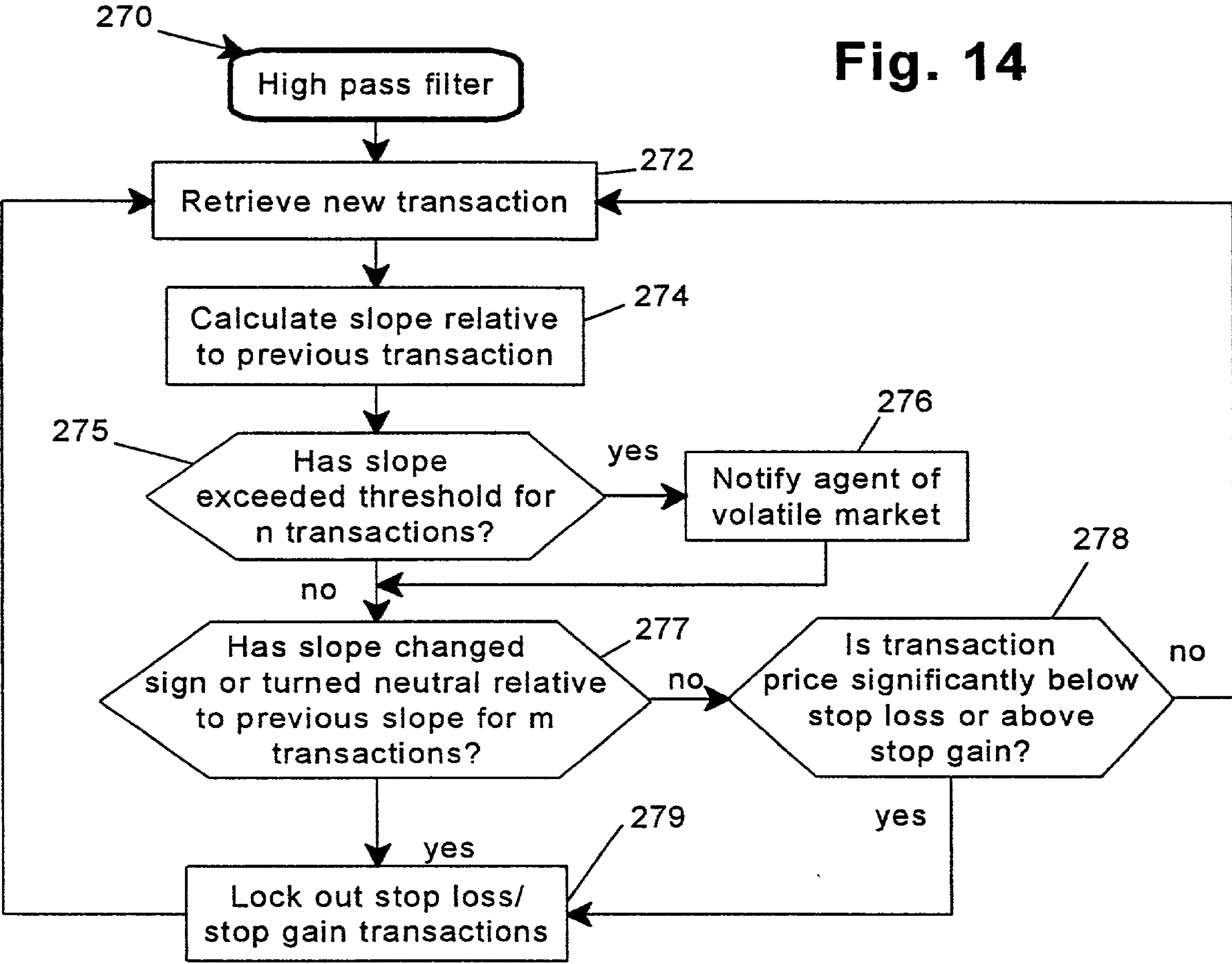




Fig. 14



United States Patent Application

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that

I verily believe I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: **INTELLIGENT AGENT WITH NEGOTIATION CAPABILITY AND METHOD OF NEGOTIATION THEREWITH**

The specification of which

- a. ☒ is attached hereto  
 b. ☐ is entitled \_\_\_\_\_, having an attorney docket number  
 c. ☐ was filed on \_\_\_\_\_ as application serial no. \_\_\_\_\_ and was amended on \_\_\_\_\_ (if applicable) (in the case of a PCT-filed application) described and claimed in international no. \_\_\_\_\_ filed \_\_\_\_\_ and as amended on \_\_\_\_\_ (if any), which I have reviewed and for which I solicit a United States patent.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56 (attached hereto).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119/365 of any foreign application(s) for patent of inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on the basis of which priority is claimed:

- a. ☒ no such applications have been filed.  
 b. ☐ such applications have been filed as follows:

FOREIGN APPLICATION(S), IF ANY, CLAIMING PRIORITY UNDER 35 USC § 119			
COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	DATE OF ISSUE (day, month, year)
ALL FOREIGN APPLICATION(S), IF ANY, FILED BEFORE THE PRIORITY APPLICATION(S)			
COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	DATE OF ISSUE (day, month, year)

I hereby claim the benefit under Title 35, United States Code, § 120/365 of any United States and PCT international application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. APPLICATION NUMBER	DATE OF FILING (day, month, year)	STATUS (patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or patent agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith:

Adriano, Sarah B.	Reg. No. 34,470	Kettelberger, Denise	Reg. No. 33,924
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Daulton, Julie R.	Reg. No. 36,414	Reiland, Earl D.	Reg. No. 25,767
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Hassing, Thomas A.	Reg. No. 36,159	Welter, Paul A.	Reg. No. 20,890
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Johnston, Scott W.	Reg. No. 39,721	Xu, Min S.	Reg. No. 39,536
Kastelic, Joseph M.	Reg. No. 37,160		
Garnett, Pryor A.	Reg. No. 32,136	Roth, Steven W.	Reg. No. 34,712
Truelson, Roy W.	Reg. No. 34,265	Gamon, Owen J.	Reg. No. 36,143
Bussan, Matthew J.	Reg. No. 33,614	Ojanen, Karuna	Reg. No. 32,484
Hughes, Christopher A.	Reg. No. 26,914	Pennington, Edward A.	Reg. No. 32,588
Hoel, John E.	Reg. No. 26,279	Redmond, Jr., Joseph C.	Reg. No. 18,753

I hereby authorize them to act and rely on instructions from and communicate directly with the person/assignee/attorney/firm/ organization who/which first sends/sent this case to them and by whom/which I hereby declare that I have consented after full disclosure to be represented unless/until I instruct Merchant, Gould to the contrary.

Please direct all correspondence in this case to Merchant, Gould, Smith, Edell, Welter & Schmidt at the address indicated below:

3100 Norwest Center, Minneapolis, MN 55402-4131  
Telephone No. (612) 332-5300

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

2	Full Name Of Inventor	Family Name BIGUS	First Given Name JOSEPH	Second Given Name PHILLIP
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			3/17/97	
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			3/14/97	
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Signature of Inventor 203:			Date:	
			3/18/97	



**§ 1.56 Duty to disclose information material to patentability.**

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

- (1) prior art cited in search reports of a foreign patent office in a counterpart application, and
- (2) the closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and

- (1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim;
- (2) It refutes, or is inconsistent with, a position the applicant takes in:
  - (i) Opposing an argument of unpatentability relied on by the Office, or
  - (ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

- (1) Each inventor named in the application;
- (2) Each attorney or agent who prepares or prosecutes the application; and
- (3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

<b>Applicant:</b>	Joseph Phillip Bigus et al	<b>Art Unit:</b>	Unknown
<b>Serial No.:</b>	08\821,935	<b>Examiner:</b>	Unknown
<b>Filed:</b>	March 21, 1997	<b>Atty. Ref.:</b>	IBM RO996-054 WH&E IBM/02/234
<b>Title:</b>	INTELLIGENT AGENT WITH NEGOTIATION CAPABILITY AND METHOD OF NEGOTIATION THEREWITH		

---

**SUBSTITUTE POWER OF ATTORNEY AND CERTIFICATE**  
**UNDER 37 CFR 3.73(B)**

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

On behalf of the assignee of the above-identified application, I hereby revoke any and all Powers of Attorney previously signed with respect to the above and instead appoint the following attorney(s) and/or agent(s), with full power of substitution and revocation, to prosecute this application, to transact all business in the United States Patent and Trademark Office connected herewith, and to receive the Letters Patent:

John D. Poffenberger	Reg. No. 20,245	Bruce Tittel	Reg. No. 22,324
Donald F. Frei	Reg. No. 21,190	David J. Josephic	Reg. No. 22,849
A. Ralph Navaro, Jr.	Reg. No. 23,050	David S. Stallard	Reg. No. 25,930
J. Robert Chambers	Reg. No. 25,448	Gregory J. Lunn	Reg. No. 29,945
Kurt L. Grossman	Reg. No. 29,799	Clement H. Luken, Jr.	Reg. No. 32,742
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Herbert C. Brinkman	Reg. No. 16,955	Richard H. Evans	Reg. No. 19,755
Pryor A. Garnett	Reg. No. 32,136	Steven W. Roth	Reg. No. 34,712
Roy W. Truelson	Reg. No. 34,265	Owen J. Gamon	Reg. No. 36,143
Matthew J. Bussan	Reg. No. 33,614	Karuna Ojanen	Reg. No. 32,484
Christopher A. Hughes	Reg. No. 26,914	Edward A. Pennington	Reg. No. 32,588
John E. Hoel	Reg. No. 26,279	Joseph C. Redmond, Jr.	Reg. No. 18,753



Please direct all correspondence in this case to:

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Wood, Herron & Evans, L.L.P.  
2700 Carew Tower  
Cincinnati, Ohio 45202

CERTIFICATE UNDER 37 CFR 3.73(B)

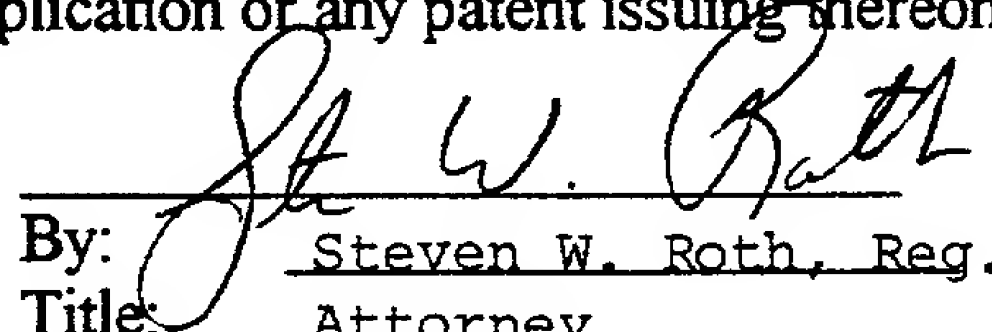
International Business Machines Corporation, a New York corporation, certifies that it is the assignee of the entire right, title and interest in the patent application identified above by virtue of an assignment from the inventor(s) of the patent application identified above. A copy of the assignment is attached hereto.

The undersigned has reviewed all the documents in the chain of title of the patent application identified above and, to the best of undersigned's knowledge and belief, title is in the assignee identified above.

The undersigned (whose title is supplied below) is empowered to sign this certificate on behalf of the assignee.

I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further, that these statements are made with the knowledge that willful false statements, and the like so made, are punishable by fine or imprisonment, or both, under Section 1001, Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: June 9, 1997

By:   
Title: Steven W. Roth, Reg. No. 34,712  
Attorney

Enc: Copy of Assignment

K:\ibm\02\Substitute Power of Attorney-02.wpd